RESEARCH AND EXPERIMENTATION TAX CREDIT

HEARINGS

BEFORE THE

SUBCOMMITTEE ON OVERSIGHT

OF THE

COMMITTEE ON WAYS AND MEANS

HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

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CONTENTS

Page

Press releases announcing the hearings ... 1

WITNESSES

Congressional Budget Office, Hon. Rudolph G. Penner, Director ... 55
Department of the Treasury, Ronald A. Pearlman, Acting Assistant Secretary for Tax Policy ... 25
National Science Foundation, Dr. Richard S. Nicholson, Acting Deputy Director ... 64
U.S. General Accounting Office, Johnny C. Finch, Senior Associate Director, General Government Division, John Gunner, Group Director, and Tom Wolters, Senior Evaluator ... 11

Acme-Cleveland Corp., W. Paul Cooper ... 213
AGS Computers, Inc., Lawrence J. Schoenberg ... 504
American Electronics Association, Joseph A. Saloom ... 448
American Enterprise Institute for Public Policy Research, Kenneth M. Brown. ... 186
American Psychological Association, Alan G. Kraut ... 765
American Society for Engineering Education, Stephen Kahne ... 739
American Telephone & Telegraph Co., Ian M. Ross ... 429
Apple Computer, Inc., Michael D. Rashkin and Charles M. Cooke ... 224
Association for the Advancement of Psychology, Alan G. Kraut ... 765
Association of American Universities, Steven C. Beering, M.D ... 731
Association of Data Processing Service Organizations, Inc., Lawrence J. Schoenberg ... 504
AT&T Bell Laboratories, Ian M. Ross ... 429
Beering, Steven C., M.D., Association of American Universities, and National Association of State Universities and Land-Grant Colleges ... 731
Braverman, David J., McGraw-Hill Economics ... 191
Brown, Kenneth M., American Enterprise Institute for Public Policy Research ... 186
Bryan, L. Thomas, Jr., New England Council, Inc ... 696
Chamber of Commerce of the United States, C. William Schick ... 390
Commtech International, Martin Knestrick ... 499
Computer & Business Equipment Manufacturers Association, John A. Young.. 402
Cooke, Charles M., Apple Computer, Inc ... 224
Cooper, W. Paul, Acme-Cleveland Corp., and National Machine Tool Builders' Association ... 213
Cordes, Joseph J., George Washington University ... 157
DeConcini, Hon. Dennis, a U.S. Senator from the State of Arizona ... 6
Deloitte Haskins & Sells, James D. Mungovan ... 496
Dukakis, Hon. Michael S. (*See,* Massachusetts, Commonwealth of.)
Eisner, Robert, Northwestern University ... 71
Electronic Industries Association, Peter F. McCloskey and Richard F. Irwin..... 274
Federation of Behavioral, Psychological, and Cognitive Sciences, Alan G. Kraut ... 765
Gould Inc., Michael I. Miller ... 691
Halpern, James S., Baker & Hostetler, Washington, DC ... 210
Hewlett-Packard Co., John A. Young ... 402
Hickey, John T., Motorola, Inc., and Semiconductor Industry Association ... 558
International Business Machines Corp., Allen J. Krowe ... 422
International Telephone & Telegraph Corp., Richard F. Irwin ... 274

Page
Irwin, Richard F., International Telephone & Telegraph Corp., and Electronic Industries Association 274
Kahne, Stephen, American Society for Engineering Education 739
Knestrick, Martin, Commtech International 499
Kraut, Alan G., American Psychological Association, Association for the Advancement of Psychology, and Federation of Behavioral, Psychological, and Cognitive Sciences 765
Krowe, Allen J., International Business Machines Corp 422
Lear Siegler, Inc., Thomas Perfitt and Richard F. Vander Veen 329
M/A-COM, Inc., Joseph A. Saloom 448
Mahapatra, S., California State University, Long Beach 524
Massachusetts, Commonwealth of:
    Evelyn F. Murphy, on behalf of Hon. Michael S. Dukakis, Governor 383
    Hon. Philip L. Shea, State senator 386
McCarthy, C. Kim, National Machine Tool Builders' Association 213
McCloskey, Peter F., Electronic Industries Association 274
McGraw-Hill Economics, David J. Braverman 191
Miller, Michael I., Gould Inc 691
Mineta, Hon. Norman Y., a Representative in Congress from the State of California 351
Motor Vehicle Manufacturers Association, John S. Nolan 246
Motorola, Inc., John T. Hickey 558
Mungovan, James D., Deloitte Haskins & Sells 496
Murphy, Evelyn F., on behalf of Hon. Michael S. Dukakis, Governor of the Commonwealth of Massachusetts 383
Mussman, Harry C., National Food Processors Association 324
National Association of Manufacturers, Robert A. Ragland 238
National Association of State Universities and Land-Grant Colleges, Steven C. Beering, M.D. 731
National Coalition for Science & Technology, Marc H. Rosenberg 709
National Food Processors Association, Harry C. Mussman 324
National Machine Tool Builders' Association, W. Paul Cooper and C. Kim McCarthy 213
New England Council, Inc., L. Thomas Bryan, Jr 696
Nolan, John S., Motor Vehicle Manufacturers Association 246
Perfitt, Thomas, Lear Siegler, Inc 329
Ragland, Robert A., National Association of Manufacturers 238
Rashkin, Michael D., Apple Computer, Inc 224
Rosenberg, Marc H., National Coalition for Science & Technology 709
Ross, Ian M., AT&T Bell Laboratories, and American Telephone & Telegraph Co 429
Saloom, Joseph A., M/A-COM, Inc., and American Electronics Association 448
Schick, C. William, United Technologies Corp., and Chamber of Commerce of the United States 390
Schoenberg, Lawrence J., AGS Computers, Inc., and Association of Data Processing Service Organizations, Inc 504
Scientific Apparatus Makers Association, James A. Taylor 435
Semiconductor Industry Association, John T. Hickey 558
Semiconductor Research Corp., Larry A. Sumney 741
Shannon, Hon. James M., a Representative in Congress from the State of Massachusetts 231
Shea, Hon. Philip L., State Senator, Commonwealth of Massachusetts 386
Sumney, Larry A., Semiconductor Research Corp 741
Taylor, James A., Varian Associates, Inc., and Scientific Apparatus Makers Association 435
United Technologies Corp., C. William Schick 390
Vander Veen, Richard F., Lear Siegler, Inc 329
Varian Associates, Inc., James A. Taylor 435
Young, John A., Hewlett-Packard Co., and Computer & Business Equipment Manufacturers Association 402
Zschau, Hon. Ed, a Representative in Congress from the State of California 355

SUBMISSIONS FOR THE RECORD

Aerospace Industries Association of America, Inc., statement 772
Aluminum Company of America, Albert E. Germain, letter 777
American Chemical Society, Warren D. Niederhauser, letter 777

Page
Association of Independent Research Institutes, Federico Welsch, letter and pamphlet ... 778
Atkins, Hon. Chet, State Senator, Commonwealth of Massachusetts, statement ... 819
Automated Financial Systems, Inc., James E. Greenwood, letter ... 790
Beck, David P., Public Health Research Institute of the City of New York, Inc., letter ... 827
Boris, Michael J., Medtronic, Inc., letter and attachment ... 822
Business Roundtable, E.G. Jefferson, letter ... 790
Computer Financial Corp., George B. Fink, letter ... 791
Consortium of Social Science Associations, statement ... 791
Coriell, Lewis L., Institute for Medical Research, letter ... 799
Engman, Lewis A., Pharmaceutical Manufacturers Association, letter ... 826
Fink, George B., Computer Financial Corp., letter ... 791
Foxboro Co., Charles A. McKay, letter ... 793
Germain, Albert E., Aluminum Company of America, letter ... 777
Global Competitiveness Council, Bruce Rubinger, letter and attachment ... 955
Greenwood, James E., Automated Financial Systems, Inc., letter ... 790
Inman, Adm. B.R., Microelectronics & Computer Technology Corp., statement. 824
Institute for Medical Research, Lewis L. Coriell, letter ... 799
International Union, United Automobile, Aerospace & Agricultural Implement Workers of America—UAW, Dick Warden, letter ... 799
Jefferson, E.G., Business Roundtable, letter ... 790
Lytle, Michael A., Texas A&M University System, statement ... 834
McKay, Charles A., Foxboro Co., letter ... 793
Machinery & Allied Products Institute, statement ... 801
Mansfield, Edwin, University of Pennsylvania, statement ... 955
Massachusetts Technology Park Corp., statement ... 821
Medtronic, Inc., Michael J. Boris, letter and attachment ... 822
Microelectronics & Computer Technology Corp., Adm. B.R. Inman, statement.. 824
Niederhauser, Warren D., American Chemical Society, letter ... 777
Otto Engineering, Inc., J.O. Roeser, letter ... 826
Pharmaceutical Manufacturers Association, Lewis A. Engman, letter ... 826
Public Health Research Institute of the City of New York, Inc., David P. Beck, letter ... 827
Richardson-Vicks, Inc., John S. Scott, letter ... 827
Roeser, J.O., Otto Engineering, Inc., letter ... 826
Rochester Tax Council, statement ... 828
Rubinger, Bruce, Global Competitiveness Council, letter and attachment ... 955
Scott, John S., Richardson-Vicks, Inc., letter ... 827
Shepherd, Mark, Jr., Texas Instruments Inc., statement ... 837
Texas A&M University System, Michael A. Lytle, statement ... 834
Texas Instruments Inc., Mark Shepherd, Jr., statement ... 837
Warden, Dick, International Union, United Automobile, Aerospace & Agricultural Implement Workers of America—UAW, letter ... 799
Welsch, Federico, Association of Independent Research Institutes, letter and pamphlet ... 778
Whirlpool Corp., letter and statement ... 839

APPENDIX

"Canadian R&D Incentives: Their Adequacy and Impact", by Donald G. McFetridge and Jacek P. Warda ... 849

RESEARCH AND EXPERIMENTATION TAX CREDIT

THURSDAY, AUGUST 2, 1984

House of Representatives,
Committee on Ways and Means,
Subcommittee on Oversight,
Washington, DC.

The subcommittee met at 10:10 a.m., pursuant to notice, in room B-318, Rayburn House Office Building, Hon. Charles B. Rangel (chairman of the subcommittee) presiding.

[Press releases announcing the hearings follow:]

[For immediate release, Tuesday, Sept. 20, 1983]

Hon. Charles B. Rangel (D., N.Y), Chairman, Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives, Announces Hearings To Be Scheduled on Research and Experimentation Expenditure Tax Issues

Congressman Charles B. Rangel (D., N.Y), Chairman of the Oversight Subcommittee of the Committee on Ways and Means announced today that hearings will be held to examine the two provisions contained in the Economic Recovery Tax Act of 1981 (ERTA) which relate to the tax treatment of research expenditures. Specifically, the Subcommittee will review the provisions which (1) provide that all research and experimental expenditures for research activities conducted in the United States be allocated or apportioned to sources within the United States, and (2) provide for a 25-percent tax credit for certain incremental research expenditures. The research source allocation rule applies only to expenditures paid or incurred during the taxpayer's first two taxable years beginning after August 13, 1981. The 25-percent tax credit applies to expenditures made after June, 1981, and before 1986. The Subcommittee's hearings are being conducted at the request of Committee on Ways and Means Chairman Rostenkowski and as part of the Oversight Subcommittee's continuing review of current Internal Revenue Code provisions.

The Subcommittee plans to conduct two separate hearing sessions. The first hearing will address the two-year research source allocation rule and will be scheduled in October. The second hearing concerning the 25-percent tax credit will be held at a later time. Details concerning the time, place and location of each hearing will be announced in subsequent press releases. A brief discussion of the scope of the Subcommittee's hearings follows:

RULE FOR ALLOCATING RESEARCH AND EXPERIMENTAL EXPENDITURES TO U.S. SOURCE INCOME

Section 223 of the Economic Recovery Tax Act of 1981 (ERTA) provides a two-year rule that allocates all research and experimental expenditures which are paid or incurred for research activities conducted in the United States to U.S. sources, for all purposes under the Internal Revenue Code (I.R.C.). This rule is effective for the taxpayer's first two taxable years beginning after the date of enactment, August 13, 1981, and has the effect of placing a temporary moratorium on the relevant portions of Treasury Regulation 1.861-8.

In addition, ERTA directs the Department of the Treasury (Treasury) to conduct a study of the impact that the research expenditure allocation provisions of Treasury Regulation 1.861-8 have on both research activities conducted in the United States and on the availability of the foreign tax credit. (Treasury released their study in June 1983 and recommended a two-year extension of the present moratorium.)

The allocation of research and experimental expenditures is important for purposes of calculating the foreign tax credit. Under I.R.C. Sections 861-3, a taxpayer is required to allocate or apportion expenses between foreign source income and U.S. source income. Treasury Regulation 1.861-8 sets forth the rules for allocating or apportioning these expenses. However, the temporary ERTA provision replaces the Treasury allocation rules and allocates all research and experimental expenditures for research activities conducted in the United States to U.S. source income (rather than between United States and foreign source income). This rule has the effect of increasing a taxpayer's foreign tax credit limit and, for many firms, the amount of the taxpayer's tax credit.

The foreign tax credit is structured to provide a taxpayer with a credit for foreign income taxes imposed on foreign income against U.S. taxes. The foreign tax credit amount is basically the lesser of the foreign tax credit limit or the amount of foreign tax paid. Taxpayers desire to increase the foreign tax credit limit amount, at least to an amount equal to the amount of the foreign tax paid, or they may find themselves in a "credit loss" situation. Allocating research and experimental expenditures as deductions against U.S. source income, rather than as deductions to reduce foreign source income, will result in an unreduced taxable foreign source income amount and therefore, a relatively higher foreign tax credit limit. Further, in some instances, a foreign country does not allow deductions against the foreign tax paid for research and experimental expenditures conducted in the United States. In such a case, expenditures allocated to foreign source income as deductions by the United States are not available to the firms to reduce the amount of foreign tax paid and further the foreign country may tax U.S. source income.

The rule in ERTA allocating all research and experimental expenditures to U.S. source income was enacted by the Congress to encourage firms to locate (or retain) their research and development activities in the United States. Firms with overseas manufacturing operations argued that Treasury's allocation rules caused firms to shift research and experimental activities to foreign countries in order to obtain a deduction in that country and thus obtain a full credit for taxes paid on the income earned in that country.

The Subcommittee hearing will (1) focus on the findings and recommendations contained in the June 1983 Treasury Report, "The Impact of the Section 861-8 Regulation on U.S. Research and Development," and other related analyses, (2) consider the policy implications of not requiring expenses to be allocated between foreign source income (including the incentive under present law to make tax free transfers of technology for use in manufacturing operations abroad), and (3) examine the research activities and location response of taxpayers who have received tax benefits under the temporary ERTA allocation rule.

TWENTY-FIVE PERCENT CREDIT FOR INCREMENTAL RESEARCH AND EXPERIMENTAL EXPENDITURES

Section 221 of the Economic Recovery Tax Act of 1981 provides for a 25 percent tax credit for certain qualified research expenditures paid or incurred by a taxpayer in carrying on a trade or business. Qualified research expenditures generally consist of "in house" expenditures by the taxpayer for research wages and supplies used in research, plus certain amounts paid for research use of laboratory equipment, computers, or other personal property, and 65 percent of certain amounts paid for contract research and basic research grants to universities and scientific research organizations. The credit applies to expenditures made after June 30, 1981, and before 1986, and is applicable to incremental expenditures above a base period amount according to the average of certain previous year expenditures.

The legislative history of the credit indicates that the 1986 sunset date was intended to give the Congress an opportunity to evaluate its operation and efficacy. Accordingly, the Subcommittee on Oversight will receive testimony on the following issues:

(1) whether the tax credit provisions should be allowed to sunset, should be extended, or should be made permanent; (2) whether the credit operates to stimulate additional research expenditures, or simply rewards increased research expenditures which would have been made in the absence of a credit, (3) a review of the types of research expenditures and industry activities that have generated use of the tax credit; (4) whether the categories of qualifying research expenditures should be broadened or narrowed; (5) whether taxpayers and the Internal Revenue Service have been able to accurately distinguish qualifying research expenditures from non-

qualifying research-related expenditures, such as indirect, overhead, or administrative wage expenditures, and from nonresearch expenditures, such as costs of market research, quality control, or production; (6) whether the base period computation rules are appropriate and have a positive impact on increasing research and experimental expenditures; (7) whether both a credit and tax deduction should be available for the same research expenditures; (8) the impact of the provisions on federal revenues; (9) the impact of the provisions on industry spending and allocation of research expenditure budgets; (10) whether the restrictions and limitations on the availability of the use of the credit have been effective to accomplish Congressional intent; and (11) in the event the credit is continued, whether any statutory or administrative changes should be made.

[For immediate release, Monday, June 4, 1984]

HON. CHARLES B. RANGEL (D., N.Y.), CHAIRMAN, SUBCOMMITTEE ON OVERSIGHT, COMMITTEE ON WAYS AND MEANS, U.S. HOUSE OF REPRESENTATIVES, ANNOUNCES THE SCHEDULING OF HEARINGS ON THE RESEARCH AND EXPERIMENTATION TAX CREDIT

The Honorable Charles B. Rangel (D., N.Y.), Chairman of the Subcommittee on Oversight of the Committee on Ways and Means, announced today hearings have been scheduled to examine the twenty-five percent tax credit for certain incremental research and experimentation expenditures. The hearings have been scheduled for Tuesday, July 31, and Wednesday, August 1, 1984, beginning each day at 10 a.m. in the Committee's main hearing room, 1100 Longworth House Office Building, Washington, D. C. The Subcommittee's hearings are being conducted at the request of Committee Chairman Rostenkowski and as part of the Oversight Subcommittee's continuing review of current Internal Revenue Code provisions.

Section 221 of the Economic Recovery Tax Act of 1981 provides for a twenty-five percent tax credit for certain qualified research expenditures paid or incurred by a taxpayer in carrying on a trade or business. Qualified research expenditures generally consist of "in house" expenditures by the taxpayer for research wages and supplies used in reseach, plus certain amounts paid for research use of laboratory equipment, computers, or other personal property, and sixty-five percent of certain amounts paid for contract research and basic research grants to universities and scientific research organizations. The credit applies to expenditures made after June 30, 1981, and before 1986, and is applicable to incremental expenditures above a base period amount according to the average of certain previous year expenditures.

In announcing the hearings, Chairman Rangel stated, "While the research credit does not expire until the end of 1985, there is considerable interest in addressing the credit this year. The Subcommittee had hoped to begin its examination of this matter at an earlier time, but has delayed its oversight review until a study on the impact of the credit is completed by the General Accounting Office (GAO). The GAO study is scheduled to be submitted to the Subcommittee on July 20, 1984. I hope other witnesses will also address issues beyond whether the existing credit ought to be extended."

As announced in an earlier press release (press release #8, dated September 20, 1983), the Subcommittee will receive testimony on the following issues: (1) whether the tax credit provisions should be allowed to sunset, should be extended, or should be made permanent; (2) whether the credit operates to stimulate additional research expenditures, or simply rewards increased research expenditures which would have been made in the absence of a credit; (3) the types of research expenditures and industry activities that have generated use of the tax credit; (4) whether the categories of qualifying research expenditures should be broadened or narrowed; (5) whether taxpayers and the Internal Revenue Service have been able to accurately distinguish qualifying research expenditures from non-qualifying research-related expenditures, such as indirect, overhead, or administrative wage expenditures, and from nonresearch expenditures, such as costs of market research, quality control, or production; (6) whether the base period computation rules are appropriate and have a positive impact on increasing research and experimental expenditures; (7) whether both a credit and tax deduction should be available for the same research expenditures; (8) the impact of the provisions on federal revenues; (9) the impact of the provisions on industry spending and allocation of research expenditure budgets; (10) whether present law rules on the availability of the use of the credit have been effective to accomplish Congressional intent; and (11) in the event the credit is continued, whether any statutory or administrative changes should be made.

The Subcommittee plans to receive testimony from the Department of the Treasury, the Congressional Budget Office, the National Science Foundation, tax and economic experts, interested industry groups, and other invited and public witnesses. In addition, the General Accounting Office will present the results of its study (scheduled to be completed on July 20, 1984) which the Subcommittee requested earlier this year regarding the impact of the tax credit on research and experimentation activities under present law.

DETAILS FOR SUBMISSION OF REQUESTS TO BE HEARD

Individuals and organizations interested in presenting oral testimony before the Subcommittee must submit their requests to be heard by telephone to Harriett Lawler [(202) 225-3627] no later than close of business, Friday, July 20, 1984, to be followed by a formal written request to John J. Salmon, Chief Counsel, Committee on Ways and Means, U.S. House of Representatives, 1102 Longworth House Office Building, Washington, D.C. 20515. Notification to those scheduled to appear will be made by telephone as soon as possible after the filing deadline.

It is urged that persons and organizations having a common position make every effort to designate one spokesperson to represent them in order for the Subcommittee to hear as many points of view as possible. Time for oral presentations will be strictly limited with the understanding that a more detailed statement may be included in the printed record of the hearings. This process will afford more time for members to question witnesses. In addition, witnesses may be grouped as panelists with strict time limitations for each panelist.

In order to assure the most productive use of the limited amount of time available to question hearing witnesses, witnesses scheduled to appear before the Subcommittee are required to submit 100 copies of their prepared statements to the full Committee office, room 1102 Longworth House Office Building, at least 24 hours in advance of their scheduled appearances. Failure to comply with this requirement may result in the witness being denied the opportunity to testify in person.

Requests to be heard must contain the following information:

(1) The name, full address, and capacity in which the witness will appear, as well as a telephone number where the witness or a designated representative may be reached;

(2) A list of any clients or persons, or any organization for whom the witness appears; and

(3) A topical outline or summary of comments and recommendations.

The above information should also be incorporated in the prepared statements to be presented in person as well as those filed for the printed record of the hearings.

WRITTEN STATEMENT IN LIEU OF PERSONAL APPEARANCE

Persons submitting a written statement in lieu of a personal appearance should submit at least six (6) copies of their statement by the close of business, Friday, August 17, 1984, to John J. Salmon, Chief Counsel, Committee on Ways and Means, U.S. House of Representatives, Washington, D.C. 20515. If those filing written statements for the record of the printed hearings wish to have their statements distributed to the press and the interested public, they may provide 75 additional copies for this purpose to the full Committee office before the hearings begin.

[For immediate release, Tuesday, July 3, 1984]

HON. CHARLES B. RANGEL (D., N.Y.), CHAIRMAN, SUBCOMMITTEE ON OVERSIGHT, COMMITTEE ON WAYS AND MEANS, U.S. HOUSE OF REPRESENTATIVES, ANNOUNCES A CHANGE IN THE SCHEDULE OF HEARINGS ON THE RESEARCH AND EXPERIMENTATION TAX CREDIT

The Honorable Charles B. Rangel (D., N.Y.), Chairman of the Subcommittee on Oversight of the Committee on Ways and Means, announced today changes in the hearings to examine the twenty-five percent tax credit for certain incremental research and experimentation expenditures previously scheduled for Tuesday, July 31, and Wednesday, August 1, 1984. The hearings will now be held on Thursday, August 2 and Friday, August 3, 1984. The hearings will be held in the Main Committee Hearing Room, 1100 Longworth House Office Building, Washington, D.C. beginning each day at 10:00 a.m.

Individuals who have requested to be heard will be notified, as soon as possible, of the date and time they have been scheduled to appear. All other details concerning the hearings remain unchanged.

Chairman **Rangel**. It is obvious from the size of the crowd that we all know why we are here. So, let's begin the hearing.

The Subcommittee on Oversight has been assigned the responsibility by the chairman to begin examination of the 25-percent research and experimental tax credit. The credit was enacted in 1981 as a part of the Economic Recovery Tax Act.

The research credit provides a credit equal to 25 percent of the incremental amount of "qualified" research expenditures a firm makes over and above its average research spending for the 3 prior years.

A taxpayer's research expenditures eligible for the credit consist of:

One, "in-house" expenditures for wages and supplies used in research, plus certain lease payments.

Two, 65 percent of amounts paid for certain contract research.

Three, 65 percent of amounts paid for certain basic research performed by universities and scientific organizations.

The R&E credit is scheduled to expire at the end of 1985.

Because of the scheduled expiration of the credit and broad congressional and national interest in encouraging research in the United States, these hearings are designed to accomplish several objectives:

To determine the credit's impact, to date, on U.S. research activities.

To determine whether the credit (as it is presently structured) is effective in stimulating additional research activities.

In the event the credit is continued, what changes the Congress should consider to make it more effective.

We have tried to bring in as many people as possible to have the benefit of as many different views as possible. We hope that the witnesses will try to restrict their testimony to 5 minutes. Your complete statement will be entered into the record.

This record will remain open for that purpose until September 17 of this year.

The staff has requested that information be provided to us as to whether or not your firm or association members claimed the research tax credit. If so, for what year and what amount; the types of research activities for which the credit had been claimed; and the type of improvement and product to which the research relates.

What is important to members of the committee and the Congress is whether the credit is being taken for the types of activities that the Congress intended it to be used for and whether these activities would have occurred without the credit.

We are concerned with the cost of the credit. Some of us believe we are going to have to have a revenue-producing year next year unless, as the President predicts, we have a miraculous recovery that is going to wipe out the deficit.

Our first witness will be Senator DeConcini. His testimony will be followed by Government and administration witnesses, and perhaps other Members of the Senate.

Let me personally welcome you, Senator, for the expertise that you have consistently brought to the Senate and for sharing it with those of us on the other side.

STATEMENT OF HON. DENNIS DeCONCINI, A U.S. SENATOR FROM THE STATE OF ARIZONA

Senator DECONCINI. Thank you, Mr. Chairman.

Let me truly thank you on behalf of many constituents in Arizona who are concerned about this legislation. I would also like to compliment you and the full committee for doing the oversight early, in time to get a handle on the issue. I really believe that it is one of the most significant pieces of legislation that your committee will consider next year.

I am pleased to have an opportunity to testify on the subject of the tax credit for research and development activity. You may know, Mr. Chairman, that I am the author of a flat tax proposal in the Senate. While I am not a member of the Finance Committee, I have spent a good deal of time considering the implications of many aspects of our present tax structure.

Today I would like to share my thoughts with the subcommittee as you inquire into the performance of the R&D credit. At the outset, I want to assure you that I do consider my advocacy for overhaul of the tax structure to be entirely consistent with my support for preservation of valuable economic incentives like the R&D credit. Until we accomplish a complete overhaul of our outmoded and outdated tax system, I will continue to work toward proper incentives within it. My proposal introduced this year as S. 557, would apply a flat across-the-board tax rate of 19 percent to all income—personal and corporate no exemptions, deductions or credits. The choice of a 19-percent flat tax rate figure in my bill is no accident and is relevant to your inquiry here today.

Nineteen percent represents the figure likely to assure that this Nation's revenue requirements are fully funded. If you stop and look at the number of corporate taxpayers whose tax burden exceeds that figure—in some cases, more than double that figure—it is quickly evident that the tax burdens of our society are not evenly distributed.

Healthy, economically contributory, corporate taxpayers are valuable resources. But a business such as the electronics industry which pays twice as much into the Treasury as a "fair share" allocation would mandate is clearly helping to subsidize other less productive sections of the economy. I am not a tax economist, but it is clear to me that there is merit to providing tax consideration to blunt the impact of disproportionate taxation on taxpayers which are contributing to the economy. Until we can overhaul the system, incentives for productivity and efficiency are, it seems to me, not only fair and just, but absolutely necessary. The R&D credit is, in my view, one such incentive.

In Arizona, the electronic manufacturing industry has taken great advantage of this credit. Over 100,000 Arizonans are employed by this industry and it continues to grow in my home State and elsewhere. These companies manufacture computers, satellites, telecommunications equipment, semiconductors, and other electronics gear, and are engaged in fiercely competitive worldwide markets. They often find themselves going head-to-head against foreign companies which are being helped with direct subsidies from their own governments.

The "engine" of the high tech industry is innovation—coming to market with a faster computer, a more powerful chip, a smaller radio telephone. The source of innovation is research. The R&D credit plays a crucial role in keeping U.S. electronics companies competitive—it helps to "fuel" their competitive engines by providing an incentive to increase the rate of investment in R&D. The greatest benefit of the credit is the possibility of expanding the number of speculative research efforts which an innovative company can undertake. Not all research is fruitful in the marketplace, but the more that is tried, the greater the likelihood that the next great success will emerge.

I have heard this message from my high tech constituents time and time again and I have seen it working in their plants in my State. Indeed, not only electronics, but steel, chemical, mining, textile, and pharmaceutical companies have had their research efforts sparked by the credit.

You will be hearing from all of these groups, along with others who have problems with the way credit has been set up and used.

I want to thank you for taking the time to listen to these witnesses. I know what your time is like, serving in a similar capacity on the Appropriations Committee, but it is so crucial and it is so important.

As a proposer of reform, I could cast stones, too. Frankly, however, I don't believe that any of the critics of the R&D credit have suggested anything that the business community itself hasn't proposed, as a way of tightening up on the credit. I urge you to listen closely to the statements of industry in this regard.

Mr. Chairman, we have a lot of problems with our tax system. But we are not going to solve them all in a hurry. Some taxpayers are strong, disproportionate contributors to our Nation's economic health. Other industries which are not now performing as well will eventually improve their productivity and their ability to contribute to the economic health of the Nation if they invest in research and implement innovations. Let's help keep the productive industries competitive and productive.

The prospects for our economy are dim indeed if we don't innovate; as long as the tax code retains its present inefficiencies and inequities—and until we put into place a flat tax proposal—mechanisms like the R&D credit must be viewed as necessary, useful tools to keep U.S. industries flourishing.

Thank you for your time. I appreciate your letting me testify as your leadoff witness this morning because of the appropriations conference committee that began 15 minutes ago.

Chairman RANGEL. Thank you, Senator. We will keep in touch with you.

I join with you in wanting to reform the tax system as long as it does not interfere with many of the incentives my constitutents need for equity and fairness. We all want to close up some of those loopholes that the other people have.

I understand that the other body has approved some type of bill that would allow larger companies to merge for purposes of R&D.

Senator DECONCINI. That is correct. We have passed the bill on the antitrust R&D that would permit the sharing and some limited disclosure of the patents and the trade information that they have.

It is a carefully worded bill that has Senator Metzenbaum's and Senator Hatch's, two different perspectives, agreement on that bill.

Chairman RANGEL. Are the industries targeted or is it across the board like the existing law?

Senator DECONCINI. It is across the board, but it permits the industry to share R&D without being in violation of the antitrust laws.

Chairman RANGEL. Is it possible then for McDonalds and Burger King and all of them to join together to use this to perfect a better hamburger, as I understand some of these credits are being used?

Senator DECONCINI. We did not delve in the hearing process into the use in such businesses. We were primarily dealing with high-tech industries, competitive overseas industries, that made a very good case in testimony that they were really cramped and were noncompetitive with foreign high tech industries.

Chairman RANGEL. Your testimony seems to be targeted in that area.

Would you suggest that, if we want to extend the credit, that we take a look to see whether it should be targeted to certain types of competitive industries rather than fashion designers and fast food operators?

Senator DECONCINI. Yes, sir. I think really this credit here is primarily to be sure that the United States is competitive with some of our high-tech competitive allies and friends who have direct or indirect Government subsidies.

We don't have that except that this tax credit is a subsidy. But legitimate subsidy encourages R&D investment and that is what we need to be competitive. It should not be totally across the board, it should be restricted.

Chairman RANGEL. We will need your views in the future on this.

Mr. Dorgan.

Mr. DORGAN. Thank you, Mr. Chairman.

Senator, our question with respect to this credit is with what efficiency is this credit being used? If the Government forgoes revenue that it needs or otherwise it ought to have, what is it getting for that forgone revenue?

I think those are legitimate questions to ask with respect to every line on the income tax return, every exemption, every exclusion. We are starting to have to do more and more of that because of the Government deficit.

Research and development is critical for the economic health of this country and for this country's enterprise to stay competitive around the world. I share your interests about that.

I would like to ask you more of a general question. I have been thinking lately about full integration of the corporate income tax which would suggest elimination of the corporate income tax, taxing corporate profits at the stockholders' source.

If that were the case, if you essentially eliminated the corporate income tax, you would obliterate all the tax deductions you are talking about.

What is the Government's responsibilities and function in the R&D of the type you are talking about?

Senator DECONCINI. Mr. Chairman, that is an interesting proposal and one that I would not pretend to be an expert on. I can only give you an off-the-cuff opinion.

I would suggest, thinking about it for the first time, that maybe such an elimination would be strong encouragement, and I don't have a wording for that, that the reason for it is to promote not just greater profits and greater distribution of those profits to stockholders, but to invest in more R&D because that is where the future lies.

I know, in my State, Motorola, Digital, companies like that, that is where their future lies. Digital is a good example. It pays little or no dividends because their profits go into R&D to be competitive, and they are. This credit has been very, very helpful.

A company like that, if it had an integrated corporate income tax, I think would invest. Whether all companies would, I don't know. Maybe that is where the free market should manage itself. But I like this incentive because it says you will be rewarded for taking the chance that you are going to be more competitive.

I am also a strong proponent of eliminating all of these tax credits and deductions. As the chairman said, I would eliminate them for my own constituents, if we really put in some kind of flat tax or some kind of new system. In that case, I wouldn't be here saying, well, don't forget us cotton farmers in the West or hydroelectric powerplants, that we need some incentive. I am willing to go the whole route if we do it for everybody.

Mr. Chairman, I am very young, like you—still idealistic, like you are—and I would like to think sometime the Ways and Means Committee and Finance Committee will truly address that particular problem, maybe not the DeConcini proposal or Bradley proposal, but the Rangel proposal or Dorgan proposal, that would get at the major numbers of all of these deductions or credits.

Mr. DORGAN. I have discovered that there is a constituency for everything, including waste.

Chairman RANGEL. Solid waste.

Mr. DORGAN. There is a constituency for every single provision in the Internal Revenue Code, every one. That is what makes it difficult for us to make the changes that are necessary.

With respect to R&D credits, we want to know with what efficiency those are being used because it is revenue forgone.

As the chairman alluded, are we using R&D credits to perfect a Chicken McNugget, a skinless tomato, a banana that tastes like an orange?

Is the use of these credits really moving us in the direction of being able to compete more effectively in international markets?

We have some serious problems ahead of us in American industry in being able to compete in the years ahead.

Aside from these questions, we can hardly compete with some of the toughest competitors around this world in the future while we pay $1,000 per capita per year in this country for defense and our competitors, the Japanese, West Germans and others, pay, in the Japanese case, $90 per person per year for defense. That is about $900 per person difference in commitment to defense for that umbrella over the free world.

That $900 in Japan goes into the private sector—I assume much of it for R&D. In this country it goes into the public sector in the form of taxes and over to the Defense Department to pay for jet fighter planes, tanks, and carriers.

It seems to me with that kind of imbalance and the capability that gives the West Germans, Japanese, and others for R&D in the private sector to build better toasters, better television sets, better Toyotas, I don't see unless we correct that imbalance, we will be able to compete 20, 30, 40 years from now.

That is a serious problem and it deals specifically, in my judgment, with R&D capability in our country vis-a-vis our competitors.

Senator **DeConcini**. Mr. Chairman, Mr. Dorgan raises a good point because I don't quarrel with our spending a larger amount than Japan or West Germany.

I do quarrel with the amount that the Reagan administration has thrust upon us. I happen to be a Senator who believes in a strong defense, as I am sure many of you do. What is really the point is that we are carrying the burden for someone else.

Mr. Dorgan, you pointed out so well the inconsistencies of our umbrella for the Japanese who are fine allies and a part of the free world, but they have to bear the responsibility of their nation and the international security that we presently supply to them.

I think you raise a very, very important point.

Mr. **Dorgan**. Mr. Chairman, we all agree in tax fairness and a strong America.

Senator **DeConcini**. Please approve this bill before you do the flat tax.

Chairman **Rangel**. Thank you for your well thought out remarks.

Senator **DeConcini**. Thank you, Mr. Chairman.

Chairman **Rangel**. Our next witness will be from the General Accounting Office, Johnny C. Finch, who is Senior Associate Director of the General Government Division.

Mr. Finch, we recognize the short notice that was given in order for you to present to us your findings on the use and effectiveness of this tax.

We also know that your time was limited in acquiring the type of IRS information that you would need to give us a more full report.

In any event, we appreciate what you have done for us. You know that we will not be legislating this year. We hope that you can keep this as a basis, updating it as more data becomes available to you.

As you well know, the record will remain open until September 17. The committee will be still in touch with you for any additional information that you have.

We have your testimony and without objection, it will be entered into the record. We hope that you might highlight and summarize it for us this morning.

STATEMENT OF JOHNNY C. FINCH, SENIOR ASSOCIATE DIRECTOR, GENERAL GOVERNMENT DIVISION, U.S. GENERAL ACCOUNTING OFFICE, ACCOMPANIED BY JOHN GUNNER, GROUP DIRECTOR, AND TOM WOLTERS, SENIOR EVALUATOR

Mr. FINCH. Thank you, Mr. Chairman.

Before I begin, may I introduce the people at the table with me. To my left is John Gunner. John is our group director who manages GAO's work in the tax area.

To my right is Tom Wolters, a senior evaluator who directed the work that was done in response to your specific request, the results of which we will report on this morning.

Mr. Chairman and members of the subcommittee, we are pleased to be here today to assist the subcommittee in its inquiry into the use and effectiveness of the research and experimentation tax credit.

The credit, which was enacted as part of the Economic Recovery Tax Act of 1981, authorizes certain taxpayers to reduce their income tax liabilities by a percentage of the amount spent on qualified research and experimentation. Through this legislative provision, the Congress sought to encourage business firms to perform the research and experimentation necessary to increase the overall competitive stance of the U.S. economy.

The tax credit is scheduled to expire on December 31, 1985.

Today, this subcommittee is holding hearings with a view toward determining whether the credit should be retained beyond 1985 and, if so, whether the credit should be modified to make it more effective.

In preparation for this hearing, the subcommittee asked us to gather certain information on industry and IRS experience with the credit.

Due to time constraints, we did not attempt to develop a complete scientific analysis of the use and effectiveness of the research and experimentation tax credit. We tried instead to quickly identify, and then gather information on, a judgmental sample of companies that were potential users of the tax credit.

In so doing, we recognized that any data we developed would not be projectable to larger populations. Although the information we developed is not statistically projectable, we nonetheless believe that it provides some insight into issues relating to the tax credit which should prove helpful in the congressional decisionmaking process.

We identified our sample of companies through several different sources including:

First, data filed by public corporations with the Securities and Exchange Commission concerning their expenditures on research and development activities.

Second, IRS-provided information pertaining to taxpayers who had claimed the tax credit.

Third, a listing of high technology companies provided to us by a trade association representative.

We found that a wide variety of companies had claimed the tax credit. Of the 109 tax credit users, included in our sample, 172 or 82 percent were involved in manufacturing operations. Their products included chemicals, metal implements, machinery, computer hardware, software, electronic equipment, and transportation equipment in part and many others.

The remaining 37 companies included service companies such as banks, credit bureaus and providers of data processing and health services as well as product wholesalers and retailers, public utilities and mining firms.

Besides identifying the users of the tax credit, we tried to make two determinations about the activities for which the credit was claimed.

First, we wanted to find out in broad terms the kind of research and experimentation activities engaged in by various users of the credit.

Second, we wanted to determine, where feasible, the types of research and experimentation activities that were initiated at the margin. We asked various companies to tell us whether the tax credit had enabled them to undertake research that otherwise would not have been undertaken.

We were able to obtain broad information on the research and experimental activities engaged in by 182 of the 289 tax credit users included in the sample. We obtained this information through interviews and/or IRS-supplied tax information.

A total of 139 companies were involved in research activities directed at developing new products and/or improving existing products. New and improved products included medical equipment, machinery, drugs, food products, smoke detectors, oil seals, engines, and brakes.

In contrast, research activities for 44 companies involved the development of new or improved processes. For example, mining and oil companies were seeking to develop new techniques for the extraction of ores, oil, and fuel. Some manufacturing companies were attempting to develop new production techniques for electronic equipment associated with aerospace experimental projects as well as for processing new fuel and oil additives.

The research activities for 43 companies involved computer software applications. These companies included banks, credit bureaus, and utilities, as well as companies for which computer software was a major product line. Software-related activities included the development of new computer programs and the enhancement of computer compatibility.

Besides gathering broad, overall information on the kinds of research being conducted, we also asked company representatives whether the credit had enabled them to carry out any research and experimentation that otherwise would not have been undertaken.

We were able to obtain this information from eighty-six of the 92 companies we contacted that had used the tax credit. Of those 86 companies, five told us that the tax credit had encouraged them to initiate new research projects.

One company, for example, applied the credit to the development of new office machines, another to new automobile-related products, and a third to new uses for fiberglass. The value of the credit to these five companies for the period 1981 through 1983 was about $10.6 million.

Twenty-eight of the 86 companies told us that the credit had encouraged them to intensify the level of their ongoing research efforts. For example, one cereal company told us that it applied the credit to ongoing research in food processes and products; another company applied it to developing drugs for use in the treatment of cancer and heart disease, and a third applied it to developing equipment in the orthopedic field.

The value of the credit to these 28 companies for intensifying the level of ongoing research during the period 1981 through 1983 was about $132.4 million.

Twenty-three of the 86 companies said that the credit encouraged them both to start new efforts and to intensify ongoing efforts. The companies used the research credit to develop such products as computer hardware/software, electronic banking equipment, and interior and exterior trim for automobiles.

The value of the research credit to these 23 companies for the period 1981 through 1983 was about $394.6 million.

Finally, 30 of the 86 companies told us that the credit had no effect on their research program. That is, company officials said that they would have increased their spending on research even if the credit had not been available.

We also found that 71 potential users of the tax credit for which we gathered information had not claimed the credit for various reasons. Twenty-one corporations said that they had not claimed the credit because they had no tax liability.

Most of these firms were involved in scientific research. The credit can, however, be carried forward for up to 15 years. Thirty-five companies said that their research and experimentation expenses did not quality for tax credit purposes, as defined by law or the proposed Treasury regulations.

Other reasons cited by the 15 remaining companies for not using the credit included a lack of incremental expenditures on research and experimentation and a lack of knowledge about the credit.

Now, I would like to discuss the extent to which the credit has achieved its stated objective.

Available statistical data indicate that research and experimentation expenditures have increased since the tax credit went into effect. Some statistical evidence indicates that the research and experimentation tax credit may have achieved, at least to some extent, its intended objective.

That is, available statistics indicate that there has in fact been a substantial increase in expenditures for research and experimentation since the credit went into effect on July 1, 1981.

Other evidence, however, indicates that the tax credit may not have been the only cause for these increased expenditures. In any case, we obtained evidence as to whether the tax credit had encouraged research and experimentation from corporate tax return data for tax years 1981 and 1982.

Tax year 1981 information on 105 of our 209 tax credit users indicated that they had spent a total of $1.1 billion on qualified research and experimentation during the tax year 1980 base period.

For the comparable 1981 period when the tax credit first went into effect, the 105 companies spent nearly $1.5 billion on research and experimentation, a 37-percent increase.

For 1982, the second year in which the tax credit was in effect, we were able to obtain tax return data from 52 of our 209 users. These companies claimed an average of $664.8 million in research expenditures for base period years 1980 and 1981, but over $781 million in tax year 1982—$116.3 million or 17 percent increase.

Thus available statistics show that since the tax credit went into effect, expenditures for research and experimentation have increased at least with respect to some of the major corporations included in our sample.

In contemplating these statistics in terms of the contribution made by the tax credit, however, some consideration should be given to the effects of inflation and the possibility that taxpayer errors were made in computing both base period and incremental research and experimentation expenditures.

Some firms may have been able to claim the tax credit by maintaining a level, real rate of expenditures on research and experimentation activities. This is because the law does not take inflation into account in terms of defining incremental expenditures.

Also, there may be a question as to the extent that available statistics actually reflect increased spending on research as opposed to changes in taxpayers' classification of expenses incurred.

Thus, Mr. Chairman, while we cannot specify the exact extent to which spending on research and experimentation has increased since enactment of the tax credit in 1981, it seems clear that there has been an increase in such spending.

Available information indicates, however, that the tax credit may not have been the only reason for the increased spending and I would now like to discuss that issue.

As I previously mentioned, we were able to obtain views from representatives of 86 of the corporations in our sample that used the credit. Thirty of the eighty-six corporations, or 35 percent, told us that the tax credit had not encouraged them to carry out any more research and experimentation than otherwise would have been the case.

These companies were involved in such research activities as developing techniques for extraction of fuel, producing new products out of iron ore and nickel, and developing microelectronic and hydraulic equipment.

Various company representatives told us that factors, such as enlightened management, the need to be competitive and to increase earnings, and the need for effective long-term planning affected decisions to increase research expenditures more so than did the tax credit.

These 30 companies claimed about $26.8 million, or 5 percent, of the $564.5 million in tax credits claimed by the 86 companies which provided us with information in this area.

Also, a change in economic conditions could have been a major impetus for increased research expenditures. We noted that corporate earnings were depressed in 1980 due to the most recent recession and as a result, corporate investments in research and experimentation may have been lower than otherwise would have been the case.

In late 1982 and 1983, however, corporate profits increased substantially and thus more funds were available for research. Given that, it is possible that some firms increased their spending on research because higher profits made funds available for that purpose, not solely because of the tax credit.

On a related matter, we noted that several studies, including a Congressional Budget Office analysis, have indicated that the tax credit may not be sufficient to stimulate significant incremental investment in research and experimentation.

Also, the tax credit provides only a prospective benefit for those firms that did not incur a tax liability in the current year and 3 prior years. This was the case for 21 of the 71 companies included in our sample that had not claimed the credit, including several computer, genetic, and biotech firms.

Now I would like to discuss the tax credit in terms of forgone revenues and administrative issues. According to the latest Treasury Department estimates, at least the most recent ones we are aware of, the tax credit will result in about $7 billion in forgone tax revenues during July 1981 through December 1989.

In its anticipated peak year, 1985, Treasury expects the credit to result in forgone tax revenues of over $1.5 billion. Information we developed from tax returns showed that at least 36 of the 209 tax credit users included in our sample had claimed the tax credit for each of the 3 years we covered—1981, 1982, and 1983—and we found that tax credit claim amounts increased substantially each year for these companies.

The 36 companies claimed about $89 million in tax credits for tax year 1981. In tax year 1982, the same companies claimed over $122 million in tax credits. In tax year 1983, the 36 companies claimed over $193 million in credits.

Thus, the research and experimentation credit already has resulted in millions of dollars in forgone tax revenue.

From a tax administration perspective, the credit has caused some difficulties for both IRS and taxpayers. IRS, for example, has experienced difficulties in the form of unagreed examination cases. Through May 1984, seven IRS district offices we contacted had initiated or completed 83 examinations involving the credit.

In 30 of the 83 cases, IRS examiners believed that taxpayers had overstated their tax credit claims. But 10 of the 30 involved taxpayers have disagreed with IRS' findings.

The disagreements between IRS and the taxpayers seem to stem basically from the ambiguity of the law regarding certain qualified research expenditures. For example, 8 of the 10 unagreed cases involved issues pertaining to computer software expenses.

Basically, under present law, innovative software products would seem to qualify for the tax credit. But neither the law nor the proposed regulations define the term "innovative." Thus, it is not surprising that taxpayers would liberally classify new software as innovative whereas IRS would tend toward a more conservative interpretation of innovation.

In summary, Mr. Chairman, we have some data and information on the effectiveness of the tax credit, but some of that data and information can lead to conflicting conclusions. Given that, on the basis of our work, we cannot now recommend that the credit be made permanent.

We recognize, however, that as an alternative to making the tax credit permanent, the Congress may decide to extend the expiration date. Should this be the case, we believe that the Congress should include an important proviso, that Treasury and/or IRS systematically gather data on the tax credit so a more informed decision on its effectiveness can be made in the future.

If the decision is made to extend the credit, the Congress may also want to consider making policy revisions. The Congress may want to consider issues raised by CBO as to whether the size of the credit is appropriate.

The Congress may also want to consider whether the law should take inflation into account so as to limit the tax credits to real increases in spending on research.

Finally, the Congress may want to clarify the law where possible. For example, we found that there is a need for clarification as to whether certain computer software-related expenses qualify for tax credit purposes.

Other witnesses may point out some additional areas where clarification of the law may be appropriate.

This concludes my prepared statement, Mr. Chairman. We will be pleased to respond to any questions you might have.

[The prepared statement follows:]

STATEMENT OF JOHNNY C. FINCH, SENIOR ASSOCIATE DIRECTOR, GENERAL GOVERNMENT DIVISION, U.S. GENERAL ACCOUNTING OFFICE

Mr. Chairman and members of the subcommittee, we are pleased to be here today to assist the Subcommittee in its inquiry into the use and effectiveness of the research and experimentation tax credit. The credit, which was enacted as part of the Economic Recovery Tax Act of 1981, authorizes certain taxpayers to reduce their income tax liabilities by a percentage of the amount spent on qualified research and experimentation. Through this legislative provision, the Congress sought to encourage business firms to perform the research and experimentation necessary to increase the overall competitive stance of the U.S. economy. The tax credit is scheduled to expire on December 31, 1985.

Today, this Subcommittee is holding hearings with a view toward determining whether the credit should be retained beyond 1985 and, if so, whether the credit should be modified to make it more effective. In preparation for this hearing, the Subcommittee asked us to gather certain information in industry and IRS experience with the credit.

Due to time constraints, we did not attempt to develop a complete, scientific analysis of the use and effectiveness of the research and experimentation tax credit. We tried instead to quickly identify, and then gather information on, a judgemental sample of companies that were potential users of the tax credit. In so doing, we recognized that any data we developed would not be projectable to larger populations. Although the information we developed is not statistically projectable, we nonetheless believe that it provides some insight into issues relating to the tax credit which should prove helpful in the congressional decisionmaking process.

We identified our sample of companies through several different sources including (1) data filed by public corporations with the Securities and Exchange Commission concerning their expenditures on research and development activities, (2) IRS-provided information pertaining to taxpayers who had claimed the tax credit, and (3) a listing of high technology companies provided to us by a trade association representative.

In total, we identified and sought to obtain information on 316 companies. Of these, 209 had claimed the tax credit during tax year 1981, 1982, and/or 1983. We used the information obtained from these 209 companies to ascertain who used the credit, for what activities, and at what cost to the government. Seventy-one companies told us that they had not claimed the tax credit during those years. We used information from these 71 companies to explain why the credit was not claimed. The remaining 36 companies did not respond to our inquiries.

We interviewed representatives for 92 of the 209 companies that had claimed the tax credit. We also obtained tax return information from IRS for 45 of these 92 companies. IRS was unable to provide us with tax return information on the remaining 47 companies within the relatively short time period during which we carried out our study. For the remaining 117 of the 209 companies, we relied solely on tax return information supplied to us by IRS. Where feasible, we used the tax return information to (1) verify the information provided to us by certain companies and (2) obtain more detailed information on research and experimentation costs incurred both by companies that we contacted and by other companies that were potential users of the tax credit.

Before discussing our findings, Mr. Chairman, I think it would be helpful to provide some background information on the tax treatment of research and experimentation expenses.

BACKGROUND INFORMATION

Section 174 of the Internal Revenue Code offers taxpayers an option as to how they treat certain funds invested in research and experimentation activities. Taxpayers may elect to capitalize these investments and may write-off the amounts invested over a minimum 5-year period. Alternatively, taxpayers may elect to deduct on a current year basis the costs of "research and experimental expenditures" incurred in connection with a trade or business.

Treasury regulations under section 174 define the above statutory phrase to mean "research and development costs in the experimental or laboratory sense." This generally includes all costs incurred when developing or improving an experimental or pilot model, a plant process, a product, a formula, or an invention. The regulations further provide that qualifying research expenditures do not include costs for the ordinary testing or inspecting of materials or products for quality control or costs for efficiency surveys, management studies, consumer surveys, advertising, or promotion. Also, section 174 elections cannot be applied to costs of acquiring another person's patent, model, or production process or to research expenditures incurred in connection with literary, historical, or similar projects. Finally, expenditures to ascertain the existence, location, extent, or quality of mineral deposits, including oil and gas, are excluded.

Besides capitalizing or expending funds invested in research and experimentation activities, taxpayers also can claim a tax credit for certain incremental investments in such activities. The tax credit was enacted as part of the Economic Recovery Tax Act of 1981 and included as section 44F of the Internal Revenue Code. The credit applies only to the extent that the taxpayer's qualified expenditures for the taxable year exceed the average amount spent for research and experimentation during a base period. The rate of the credit is 25 percent of the incremental expenditure amount. Under present law, the section 44F credit applies to research expenditures paid or incurred after June 30, 1981, and before January 1, 1986.

In enacting the section 44F credit, however, the Congress expressly excluded some expenditures from the definition of qualified research. These were expenditures for: Research conducted outside the United States; research in the social sciences or humanities; and research funded by any grant, contract, or any governmental entity.[1]

Proposed Treasury Department regulations under section 44F seek to implement the Congress' intent that the credit generally be allowed for those costs allowed under section 174. That is, the regulations permit use of the tax credit for expenditures directed at developing innovative products and/or processes. But the proposed regulations are more descriptive than the section 174 regulations. For example, the section 44F regulations specifically exclude use of the credit for: The routine, periodic, or cosmetic alternation or improvement of existing products commercial production lines, or other ongoing operations; the routine design of tools, jigs, molds, and dies; the construction of copies of prototypes after construction and testing of the original prototype has been completed; planning for commercial production and trial production runs; engineering follow-through or trouble shooting during commerical production; adapting an existing capability to a particular requirement or customer's need as part of a continuing activity; and routine date collections.

Under section 44F, eligible expenditures consist of both in-house and contract costs. In-house costs consist of research-related wages, supplies, and rental expenses. Contract costs refer to expenses associated with research conducted for the taxpayer under a contract, as well as the costs associated with grants and/or contributions made to universities or certain scientific research organizations for conducting basic research. But, in contrast to in-house costs, only 65 percent of contract costs are treated as eligible expenses for purposes of section 44F.

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[1] The party that actually carries out research for a contractor generally is not eligible to claim the tax credit. Rather, it is the party which elects to fund research via contract that is eligible to claim the tax credit.

As a general rule, the section 44F credit applies to the amount of qualified research expenditures for the current taxable year that exceeds average research expenditures in the preceding 3 taxable years. The base period amount is not adjusted for inflation. For example, assume that a company had incurred eligible research expenses of $100,000 in 1980, $200,000 in 1981, and $300,000 in 1982. Subsequently, the company incurs eligible research expenses of $400,000 in 1983. For 1983, the company potentially could claim a tax credit of $50,000 or 25 percent of the difference between the 1983 expenses and the average of the previous 3 years (i.e., $400,000-$200,000 × 0.25 = $50,000).

Section 44F also contains a 50 percent limitation rule. Under this rule, base period research expenditures are treated as being at least equal to 50 percent of qualified research expenditures for the current year. This limitation affects businesses that began operating after the credit's effective date, as well as those already in existence. To illustrate, a new business with $200,000 in eligible research expenses in 1983 could earn a tax credit of $25,000 or 25 percent of the difference between the 1983 expenses and one-half of the 1983 expenses (i.e., $200,000-$100,000 × 0.25 = $25,000).

For companies already in business, the rule serves to reduce the value of the tax credit on certain incremental expenditures. Assume, for example, that a firm's average base year research and experimentation expenditures were $100,000 and that its current year expenditures total $300,000. Because base period expenses must equal at least 50 percent of current year expenses, the firm's base period expenses are deemed to equal $150,000. The firm therefore can claim a tax credit of only $37,500 ($150,000 × 0.25), instead of $50,000 ($300,000 − 100,000 × 0.25). Thus, for research and experimentation expenditures which exceed average base year expenditures by more than 100 percent, the law has the practical effect of limiting the tax credit to 12.5 percent.

In addition, the amount of the credit that may be used in a particular tax year generally is limited to the taxpayer's income tax liability. That is, a taxpayer must have a tax liability in the current or prior three years in order to gain a current benefit from the tax credit. However, the amount of the credit that cannot be applied to the current or prior three tax years can be carried forward 15 years.

I would now like to discuss our findings concerning who has used the credit.

THE TAX CREDIT HAS BEEN CLAIMED BY MANY DIFFERENT CORPORATIONS

In February 1984, the Treasury Department reported on an analysis it had done of 2,678 tax year 1981 returns. The study indicated that the research and experimentation tax credit had been claimed by a wide variety of companies engaged in many sectors of the U.S. economy. Treasury also noted that the tax credit had been claimed for a variety of different research and experimentation activities. Those claims reflected expenses incurred for research and experimentation after June 30, 1981—the effective date for section 44F. Treasury's sample of 1981 tax returns indicated that a projected 12,350 corporations had reported an estimated $3.4 billion of qualified incremental research and experimentation expenditures, for which they in turn had claimed about $858 million of research and experimentation tax credits.

Of the total amount of credit claimed by the 2,678 companies for which Treasury developed data, half went to 53 companies. Virtually all of these companies were very large corporations in terms of total assets and all spent large amounts on research and experimentation. Each of these 53 companies claimed tax credits of more than $2.3 million. Treasury found that the 53 companies could be placed in two broad categories. The first group consisted of 26 companies whose main businesses were in such "high-tech" fields as pharmaceuticals, electronics, aerospace, scientific instruments, and photographic equipment. These 26 high-tech companies accounted for $223 million in tax credit claims. The second group consisted of 27 companies in "heavy industry," such as utilities, oil companies, and companies engaged in manufacturing chemicals, rubber, steel, motor vehicles, farm and construction equipment, industrial machinery, and electrical equipment. These 27 heavy industry companies claimed $206 million in tax credits.

Beyond the 53 major corporations, numerous other companies claimed lesser tax credit amounts. According to Treasury, among the taxpayers who claimed the research and experimentation tax credit in 1981 were companies engaged in such lines of business as fast food restaurants, baked goods, home building, publishing, banking, stock brokerage, and movie production.

Our study included tax years 1981, 1982, and 1983. Like Treasury, we also found that a wide variety of companies had claimed the tax credit. Of the 209 companies included in our judgmental sample that had claimed the tax credit, 172, or 82 percent, were involved in manufacturing operations. Their products included chemicals, metal implements, machinery, computer hardware and software, electric and electronic equipment, and transportation equipment and parts. The remaining 37 companies included service companies, such as banks, credit bureaus, and providers of data processing and health services, as well as product wholesalers and retailers, public utilities, and mining firms.

Besides corporations, individual taxpayers and partnerships engaged in a trade or business also are eligible to use the tax credit. Accordingly, we sought to determine whether any individual taxpayers or partnerships had claimed the credit. We asked revenue agents in six IRS district offices—Atlanta, Dallas, Detroit, Jacksonville, Oklahoma City, and Wichita—to identify all individual and/or partnership tax returns they had audited during July 1981 through May 1984 on which the credit was claimed. The agents identified a total of 10 individual and 3 partnership tax returns on which the research and experimentation tax credit had been claimed. The low number of such returns identified was to be expected because IRS had previously estimated that only 61, or less than 1-tenth of one percent, of all tax year 1982 partnership returns contained research and experimentation tax credit claims. Similarly, IRS estimated that only 2,627, or less than 1-tenth of one percent, of all individual taxpayers had claimed the credit. Given these statistics, it appears that partnerships and individuals have not been major users of the tax credit.

Now, Mr. Chairman, I would like to discuss the activities for which the tax credit has been claimed.

THE TAX CREDIT HAS BEEN CLAIMED FOR MANY DIFFERENT ACTIVITIES

We sought to make two determinations about the activities for which the tax credit was claimed by various companies. First, we wanted to find out, in broad terms, the kinds of research and experimentation activities engaged in by various users of the credit. Second, we wanted to determine, where feasible, the types of research and experimentation activities that were initiated at the margin. That is, we asked various companies to tell us whether the tax credit had enabled them to undertake research that otherwise would not have been undertaken.

We were able to obtain broad information on the research and experimentation activities engaged in by 182 of the 209 tax credit users included in our judgmental sample. We obtained this information through interviews or from IRS-supplied tax information.

A total of 139 companies were involved in research activities directed at developing new products and/or improving existing products. New and improved products included medical equipment, machinery, drugs, food products, smoke detectors, oil seals, engines, and brakes. In contrast, research activities for 44 companies involved the development of new or improved processes. For example, mining and oil companies were seeking to develop new techniques for the extraction of ores, oil, and fuel. Some manufacturing companies were attempting to develop new production techniques for electronic equipment associated with aerospace experimental projects as well as for processing new fuel and oil additives. The research activities for 43 companies involved computer software applications. These companies included banks, credit bureaus, and utilities, as well as companies for which computer software was a major product line. Software-related activities included the development of new computer programs and the enhancement of computer compatibility.[2]

Besides gathering broad, overall information on the kinds of research being conducted, we also asked company representatives whether the credit had enabled them to carry out any research and experimentation that otherwise would not have been undertaken. We were able to obtain this information from 86 of the 92 companies we contacted that had used the tax credit. Of these 86 companies, 5 told us that the tax credit had encouraged them to initiate new research projects. One company, for example, applied the credit to the development of new office machines, another to new automobile-related products, and a third to new uses for fiberglass. The value of the credit to these five companies for the period 1981 through 1983 was about $10.6 million.

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[2] The subcategories of companies discussed in this paragraph exceed 182 because some companies were involved in multiple activities.

Twenty-eight of the 86 companies told us that the credit had encouraged them to intensify the level of their ongoing research efforts. For example, one cereal company told us that it applied the credit to ongoing research on food processes and products; another company applied it to developing drugs for use in the treatment of cancer and heart disease, and a third applied it to developing equipment in the orthopedic field. The value of the credit to these 28 companies for intensifying the level of ongoing research during the period 1981 through 1983 was about $132.4 million.

Twenty-three of the 86 companies said that the credit encouraged them both to start new efforts and to intensify ongoing efforts. The companies used the research credit to develop such products as computer hardware/software, electronic banking equipment, and interior and exterior trim for automobiles. The value of the research credit to these 23 companies for the period 1981 through 1983 was about $394.6 million.

Finally, 30 of the 86 companies told us that the credit had no effect on their research program. That is, company officials said that they would have increased their spending on research even if the credit had not been available.

As I previously mentioned, we also found that 71 potential users of the tax credit for which we gathered information had not claimed the credit for various reasons. Twenty-one corporations said that they had not claimed the credit because they had no tax liability. Most of these firms were involved in scientific research. The credit can, however, be carried forward for up to 15 years. Thirty-five companies said that their research and experimentation expenses did not qualify for tax credit purposes, as defined by law or the proposed Treasury regulations. Other reasons cited by the 15 remaining companies for not using the credit included a lack of incremental expenditures on research and experimentation and a lack of knowledge about the credit.

Now, I would like to discuss the extent to which the credit has achieved its stated objective.

AVAILABLE STATISTICAL DATA INDICATE THAT RESEARCH AND EXPERIMENTATION EXPENDITURES HAVE INCREASED SINCE THE TAX CREDIT WENT INTO EFFECT

Some statistical evidence indicates that the research and experimentation tax credit may have achieved, at least to some extent, its intended objective. That is, available statistics indicate that there has in fact been a substantial increase in expenditures for research and experimentation since the credit went into effect on July 1, 1981. In this regard, we obtained evidence as to whether the tax credit had encouraged research and experimentation from corporate tax return data for tax years 1981 and 1982. IRS was able to supply us with tax year 1981 information for 105 of the 209 companies that had claimed the tax credit. In addition, IRS supplied us with tax year 1982 information for 52 of the 209 companies. This information showed that the expenditures claimed for research and experimentation increased significantly since the tax credit went into effect in 1981.

Tax year 1981 information indicated that the 105 companies had spent a total of $1.1 billion on qualified research and experimentation during the tax year 1980 based period. For the comparable 1981 period, when the tax credit first went into effect, the 105 companies spent nearly $1.5 billion on research and experimentation—a 37 percent increase. The tax return form requires a breakdown of total qualified research and experimentation expenditures into five subcategories—wages and salaries, supplies, rental and/or lease costs, contract costs, and basic research. According to these figures, wage and salary costs incurred by the 105 companies increased by 27 percent, while supply costs grew by 43 percent. Similarly, rental and/or lease costs increased by 36 percent and contract costs grew by 293 percent. Also, the companies spent 87 percent more on basic research. From a dollar standpoint, however, wage and salary costs accounted for over $202.6 million, or 50 percent, of the overall $403.1 million increase in expenditures for research and experimentation by the 105 companies. Supply costs accounted for $118.8 million, or 29 percent, of the increase. Rental and/or lease costs, contract costs, and basic research costs accounted for the remaining $81.7 million.

For 1982, the second year in which the tax credit was in effect, we were able to obtain tax return data for 52 of the 209 companies that had claimed the tax credit. These companies claimed an average of $664.8 million in research expenditures for base period years 1980 and 1981, but over $781.1 million in tax year 1982—a $116.3 million or 17 percent increase. Costs for wages and salaries increased by 17 percent, while supply costs increased by 30 percent. Rental and/or lease costs increased by 9 percent, while basic research costs increased by 72 percent. Contract costs, however, did not increase. Again, wage and salary costs accounted for most of the dollar changes involved—$82.1 million, or 70 percent, of the $116.3 million.

Thus, available statistics show that, since the tax credit went into effect, expenditures for research and experimentation have increased, at least with respect to some of the major corporations included in our judgmental sample. In contemplating these statistics in terms of the contribution made by the tax credit, however, some consideration should be given to the effects of inflation and the possibility that taxpayer errors were made in computing both base period and incremental research and experimentation expenditures.

Some firms may have been able to claim the tax credit by maintaining a level, real rate of expenditure on research and experimentation activities. This is because the law does not take inflation into account in terms of defining incremental expenditures. Thus, to illustrate, a firm that spent $100 million for research during the 1980 base period may have found it necessary to spend $110 million in 1981, thereby compensating for the 10 percent inflation rate in 1981 while maintaining a constant level of effort. Such a firm would have carried out no real increase in research activities, yet could have earned a $2.5 million tax credit for tax year 1981.

Also, there may be a question as to the extent that available statistics actually reflect increased spending on research, as opposed to changes in taxpayers' classification of expenses incurred. Many companies told us that computation of the tax credit entailed reconstructing prior year accounting records. Before enactment of the tax credit, firms had no particular reason to segregate those research and experimentation costs that are allowable for tax credit computation purposes. Thus, there was room for error in reconstructing base year calculations.

As firms began to compute allowable research and experimentation costs in late 1981 and 1982, there also was room for error in clasifying various expenses as research-oriented. Any expense that could be so characterized would have the effect of enhancing incremental expenditure totals and thereby the amount of the current year tax credit—without necessarily increasing the actual level of research. Any such overstatements could, however, have the ultimate effect of increasing subsequent base period amounts and reducing later year tax credit claims. Whether classification difficulties did in fact affect tax credit computations is unknown, and probably will remain so unless and until IRS completes a series of examinations involving that question.

Thus, Mr. Chairman, while we cannot specify the exact extent to which spending on research and experimentation has increased since enactment of the tax credit in 1981, it seems clear that there has been an increase in such spending. Available information indicates, however, that the tax credit may not have been the only reason for the increased spending and I would now like to discuss that issue.

THE TAX CREDIT MAY NOT HAVE BEEN THE ONLY IMPETUS FOR INCREASED EXPENDITURES ON RESEARCH AND EXPERIMENTATION

As I previously mentioned, we were able to obtain views from representatives of 86 corporations in our sample that had used the credit. Thirty of the 86 companies, or 35 percent, told us that the tax credit had not encouraged them to carry out any more research and experimentation than otherwise would have been the case. These companies were involved in such research activities as developing techniques for extraction of fuels, producing new products out of iron ore and nickel, and developing micro-electronic and hydraulic equipment.

Various company representatives told us that factors such as enlightened management, the need to be competitive and to increase earnings, and the need for effective long-term planning affected decisions to increase research expenditures more so than did the tax credit. These 30 companies claimed about $26.8 million, or 5 percent, of the $564.5 million in tax credit claimed by the 86 companies which provided us with information in this area.

Also, a change in economic conditions could have been a major impetus for increased research expenditures. We noted that corporate earnings were depressed in the early 1980s due to the most recent recession. And, as a result, corporate investments in research and experimentation may have been lower than otherwise would have been the case. In late 1982 and in 1983, however, corporate profits increased substantially and, thus, more funds were available for research. Given that, it is possible that some firms increased their spending on research because higher profits made funds available for that purpose, not solely because of the tax credit.

On a related matter, we noted that several studies, including a Congressional Budget Office analysis, have indicated that the tax credit may not be sufficient to stimulate significant incremental investment in research and experimentation.

Assume, for example, that a corporate manager must decide among several options as to how to use $1 million in available funds. The manager perhaps could fund an internal training program, donate to charity, invest in securities, spend the funds on research and experimentation, etc. Assume further that the manager is 90 percent sure that an incremental investment of $1 million in research and experimentation would produce a viable, new product. Given a 25 percent tax credit, the manager actually would have only $750,000 at risk for that promising project.

Under the above scenario, the tax credit could well serve to encourage the manager to commit the $1 million to research and experimentation. But if the chances for success were only 50 percent, it is difficult to predict whether a 25 percent tax credit would have a substantial effect on the investment decision. And, if the chances for success were only 5 percent, it seems unlikely that $250,000 in tax savings would greatly influence the decision of whether to put the remaining $750,000 at risk.

Also, the tax credit provides only a prospective benefit for those firms that did not incur a tax liability in the current year or three prior years. This was the case for 21 of the 71 companies included in our sample that had not claimed the tax credit, including several computer, genetic, and biotech firms. Such firms may rely heavily on research results, but the tax credit is of no immediate value to them. The firms may, however, gain a future tax benefit due to the 15 year carry forward provision of the law.

Now, I would like to discuss the tax credit in terms of foregone revenues and administrative issues.

THE RESEARCH AND EXPERIMENTATION TAX CREDIT HAS REDUCED FEDERAL TAX REVENUES AND CAUSED ADMINISTRATIVE PROBLEMS FOR IRS AND TAXPAYERS

Taxpayer expenditures for research and experimentation can reduce federal tax liabilities in two ways. First, those expenditures frequently are considered a cost of doing business and, as such, they are deductible for federal tax purposes. This has the effect of reducing a taxpayer's taxable income. Second, those same expenses may serve as the basis for computing the research and experimentation tax credit. That credit directly offsets any existing tax liability.

According to the latest Treasury Department estimates, the research and experimentation tax credit will result in about $7 billion in foregone tax revenues during the period July 1981 through December 1989. In its anticipated peak year—1985—Treasury expects the credit to result in foregone revenues of over $1.5 billion. These estimates, of course, may be revised for a variety of reasons, including the unknown future course of the economy, the effect of any IRS examinations, and/or court rulings, etc.

Information we developed from tax returns showed that at least 36 of the 209 tax credit users included in our sample had claimed the tax credit in each of three years—1981, 1982, and 1983. And, we found that tax credit claim amounts increased substantially each year for these companies. The 36 companies claimed about $89 million in tax credits for tax year 1981. In tax year 1982, the same companies claimed over $122 million in tax credits. In tax year 1983, the 36 companies claimed over $193 million in credits. Thus, the research and experimentation tax credit already has resulted in hundreds of millions of dollars in foregone tax revenues.

From a tax administration perspective, the credit has caused some difficulties for both IRS and taxpayers. IRS, for example, has experienced difficulties in the form of unagreed examination cases. Through May 1984, seven IRS district offices we contacted had initiated or completed 83 examinations involving the credit. In 30 of the 83 cases, IRS examiners believed that taxpayers had overstated their tax credit claims. But 10 of the 30 involved taxpayers have disagreed with IRS' findings.

The disagreements between IRS and the taxpayers seem to stem basically from the ambiguity of the law regarding certain qualified research expenditures. For example, 8 of the 10 unagreed cases involved issues pertaining to computer software expenses. Basically, under present law, innovative software products would seem to qualify for the tax credit. But neither the law nor the proposed regulations define the term "innovative." Thus, it is not surprising that taxpayers would liberally classify new software as innovative whereas IRS would tend toward a more conservative interpretation of innovation.

According to IRS revenue agents, the base period feature of the tax credit has also caused problems for IRS. For example, for tax year 1981 tax credit claims, an examiner needs to verify the accuracy of claimed 1980 expenses and carry out an incremental expenditure analysis for 1981. For tax year 1982 credit claims, IRS's work needs to include 1980 and 1981 for base period purposes and 1982 for incremental spending analysis purposes. For 1983 and subsequent tax years, the base period includes 3 years plus the incremental spending analysis for the tax year at issue. Further, the difficulty of this task would be greatly compounded if the company under examination were a first time user of the credit seeking to apply carry forward credits earned in prior years. For example, a company could be eligible to claim a tax credit in tax year 1983 but might not have a tax liability against which to apply the credit until tax year 1990. Any effective future examination of that claim thus would entail an analysis of records dating back to the 1980 to 1982 base period—a most challenging task.

Taxpayers have also experienced administrative problems with the credit. Representatives for 30 of the 92 companies included in our sample said that they had experienced difficulties in deciding whether certain research and experimentation activities qualified for tax credit purposes. For example, they questioned whether certain modifications to an existing product qualified and whether certain software-related activities were allowable. Thirty-one companies told us that, once they had determined that they were engaging in qualified research activities, they had experienced difficulties in deciding whether various expenses associated with these activities could be included when computing the tax credit. This was particularly the case with indirect overhead and administrative wage and supply expenses. Further, 27 companies said that they had experienced difficulty in computing base period expenses. The companies pointed out that their accounting systems were not designed to segregate the required cost data. Therefore, they had found it necessary to reconstruct data and refine their accounting systems.

In any case, however, the aforementioned difficulties apparently were not insurmountable. According to the corporate representatives who had experienced difficulties, they generally sought to resolve questions through reliance on in-house legal and regulatory interpretations and/or private sector consultants. Some corporate representatives told us that the vagueness of the law and accompanying regulations encouraged them to claim the credit when in doubt. Some further noted that such a stance is appropriate given the lack of clarity in the law, the low risk of being selected for examination, and the low risk that a penalty will be applied in a situation where final regulations have not been issued.

In summary, Mr. Chairman, we know that a wide variety of companies have claimed the research and experimentation tax credit for many different activities. According to the Treasury Department, the primary tax year 1981 beneficiaries of the tax credit, in dollar terms, were a relatively small group of major corporations. In our judgmental sample of firms, manufacturing companies were the primary users of the credit.

Some available statistics indicate, at least on the surface, that expenditures for research and experimentation have increased since enactment of the tax credit. However, some of the increase may be attributable to inflation and/or to taxpayer reclassification errors. Other information indicates that the tax credit may not have been the only impetus for increased expenditures for research and experimentation. There also are questions as to whether a 25 percent tax credit is sufficient to stimulated a significant increase in research and experimentation, especially in high-risk areas. And, the credit provides little in a the way of an immediate incentive to spend increased funds on research and experimentation for firms that do not expect to incur a current year tax liability.

Concerning costs, we know that some corporations already have claimed millions of dollars in tax credits and that Treasury expects that the tax credit will result in foregone federal tax revenues of more than $7 billion through 1989. Also, both IRS and taxpayers have experienced some administrative difficulties with the credit.

Thus, we have some data and information on the effectiveness of the tax credit, but some of that data and informatio can lead to conflicting conclusions. Given that, we cannot now recommend that the credit be made permanent.

We recognize, however, that as an alternative to making the tax credit permanent, the Congress may decide to extend the expiration date. Should this be the case, we believe that the Congress should include an important proviso—that Treasury and/or IRS systematically gather data on the tax credit so that a more informed decision on its effectiveness can be made in the future.

If a decision is made to extend the credit, the Congress may also want to consider making some policy revisions. For example, the Congress may want to consider whether the size of the credit is appropriate. The Congress may also want to consider whether the law should take inflation into account, so as to limit the tax credit to real increases in spending on research. Finally, the Congress may want to clarify the law where possible. For example, we found that there is a need for clarification as to whether certain computer software-related expenses qualify for tax credit purposes. And, other witnesses may point out some additional areas where clarification of the law may be appropriate.

This concludes my prepared statement, Mr. Chairman. We would be pleaced to respond to any questions.

Chairman RANGEL. You have spent a lot of time talking about the amount of the credit and amount of spending.

How could you determine whether it was actual research or not?

Mr. FINCH. We basically accepted the company's word for that, sir.

Mr. GUNNER. Mr. Chairman, that will have to await the result of IRS examinations. That is when IRS will be getting into the extent of actual spending on research versus changes in accounting methods or changes in what is classified as research.

I think the IRS audits now coming on line will yield results on that aspect.

Chairman RANGEL. If you are taking the word of the taxpayer, then you are not prepared to testify whether or not this credit serves any purpose at all except to reduce tax liability.

Mr. GUNNER. I think the piece of information that the companies gave us, the ones that said the credit doesn't do much for them, is perhaps the most important piece of information that we were able to develop.

Chairman RANGEL. So the best part of your testimony relates to those people who don't use it?

Mr. GUNNER. The remaining information is subject to IRS verification.

Mr. Chairman, we do not have authority to ask the companies for records.

Chairman RANGEL. I am not asking you for your authority. I am asking in terms of common sense. Someone writes off $10 million. They say they were engaged in research.

We want to ask what did you do besides spend the money? What research? What were the findings as a result of spending the money? What benefits did you receive? Was there a better product involved?

If someone put his brother-in-law in the room and tells him to think and then writes it off, all you do is say, "Well, they spent the money. It is up to IRS to determine whether or not they came up with any new ideas."

Is that right?

Mr. FINCH. That is basically the case, Mr. Chairman.

Chairman RANGEL. We hope that you expand your sample and that the IRS can be more cooperative in giving you additional information. Our mission is to find out whether we are wasting money. We trust the taxpayers, of course, but it doesn't seem like it is making a lot of sense that people are receiving the credit, but America is not receiving the benefit from it.

So, keep us apprised as to what additional information you are able to pull together.

We thank you.

Mr. FINCH. Thank you, sir.

Chairman RANGEL. We will get all the answers now from the Department of Treasury, Ronald Pearlman, Acting Assistant Secretary for Tax Policy.

I want to thank the administration for exposing us to this way of improving our economy and making us more competitive and moving toward reducing the deficit.

I hope that we can put your entire statement, Mr. Pearlman, into the record and perhaps somewhere in your remarks you can tell us what benefit we received from the credit.

STATEMENT OF RONALD A. PEARLMAN, ACTING ASSISTANT SECRETARY (TAX POLICY), DEPARTMENT OF THE TREASURY

Mr. PEARLMAN. Thank you, Mr. Chairman.

I will try through some data that we have developed to report to you as best we can on our findings. I am appreciative of the opportunity of being here this morning to present the views of the administration on the research and experimental tax credit.

The need for and the appropriate form of the credit is a matter of continuing interest to the administration as well as to the subcommittee. We have an interagency working group that has been established, has been ongoing for some months, studying various aspects of the credit.

What I would like to do this morning is summarize our views today based on the data that we have available.

Chairman RANGEL. That will be fine, Mr. Secretary. Then it will help me and give me more time to ask some of the questions which I think the members would be interested in.

Mr. PEARLMAN. We think that the most important question with respect to the effectiveness of the credit, Mr. Chairman, is whether the definition of expenses qualifying for the credit has been drawn in a way to target the credit most efficiently.

The administration remains committed to this credit and favors extending it for an additional 3 years through 1988. As part of the extension, however, we strongly support tying the credit more closely to those private activities which are likely to result in technological innovation.

We think through a more carefully drafted definition the credit can provide an important incentive for taxpayers to undertake what we all would consider is essential research and experimentation.

Chairman RANGEL. Are you talking about targeting the credit?

Mr. PEARLMAN. We are talking about targeting. We are talking about a refinement of current definition of R&E.

Chairman RANGEL. Would that language be in your testimony?

Mr. PEARLMAN. Yes. I will try to review with you the principles. The written statement goes into much more detail.

The administration is determined to encourage the continued growth of domestic R&E. We believe that technological innovation is necessary, indeed essential, to the long-term vitality of the economy and that can only come from a substantial commitment to research and experimentation.

Without that commitment we believe our competitive position in the work economy will inevitably decline. Now, the problem with the concept of research and experimenation is that it describes and encompasses a broad variety of research activities by commercial as well as by not-for-profit corporations.

We have, for example, research embracing everything from very basic research tied to general scientific rather than specific commercial activities and research activities that do relate directly to commercial product development.

We believe that broad Government support of research and experimentation is particularly essential in the area of basic research, that is, research which by its nature cannot be expected to be self-supporting.

Although there are advances from basic research which ultimately will have commercial applications, and indeed that is one of the objectives of such research, those commercial applications are frequently too remote to permit private investors to support that research on a profitable basis.

For this reason, the Federal Government over the years has traditionally taken a lead role in funding basic research primarily through grants to universities and other educational nonprofit organizations. We believe that Government support of R&E also is appropriate, however, with respect to certain forms of research with direct commercial application.

A business will invest in R&E only to the point that the expected commercial returns are at least equal to that of alternative investments. Although opportunities for commercial profit ordinarily may reflect society's desired allocation of resources, the return to the private investor from R&E may not reflect society's true benefit from resulting innovation.

When market rewards for R&E expenditures do not match society's need for technological innovation, then it falls appropriately on Government to supply an additional incentive.

Now, under the current research and experimentation credit, the key is the definition of qualified research expenses. That definition contained in 44F of the Internal Revenue Code is defined by cross reference to a definition of research or experimental expenses under section 174 of the code which preceded the enactment of the credit.

The legislative history of the credit indicates that the existing, preexisting administrative interpretations under section 174 were intended to apply for purposes of section 44F. Regulations under section 174 define the term research or experimental expenditures to mean research and development cost in the experimental or laboratory sense and includes costs incurred to develop experimental or pilot models.

The current regulations under section 174 do not precisely identify the type of expenses qualifying as research or experimental expenditures.

Under section 174 this lack of precision may not be critical since many expenditures are deductible currently either as research or experimentation expenses or as ordinary business expenses under the general rule of section 162 of the code.

The same imprecision, however, in defining qualifying expenditures is not acceptable for purposes of the credit since it enables taxpayers to argue that virtually all preproduction costs associated with developing product qualify them for the credit. A definition which fails to focus on innovation dilutes the incentive for taxpayers to undertake truly innovative research.

Our experience with the credit is based on a very limited sample. It is based on 6 months of 1981 and it is based on preliminary tax return data for 1982.

I am going to present that data to you, as I indicated, in summary form orally, but I would caution the subcommittee as strongly as I possibly can to refrain from drawing firm conclusions from this data because only a limited period of time is involved.

Chairman RANGEL. That did not stop you from recommending an additional 3 years.

Mr. PEARLMAN. Indeed it is for that reason, Mr. Chairman, that we recommend an extension of the credit for an additional 3 years as distinguished from a permanent extension.

We believe that the current data is not adequate to derive conclusions that would go into designing a credit on a permanent basis, but we believe that as data begin to be picked up on a more definitive basis over the next several years we will have the kind of data that will enable Congress to more critically and accurately evaluate the effectiveness of the credit.

The available data that we do have, and I might point out that we did review the tax returns in which research and experimentation credits were claimed, both in 1981 and 1982, although as I noted, the data for 1982 are limited because not all of that data is yet in our system, the data that we do have do indicate that in connection with the use of the credit, that the credit was claimed primarily by large corporations.

The 12,000 corporate taxpayers claiming credit in 1981 represented 39 percent of total corporate assets and receipts, less than 1 percent of all corporations filing 1981 returns.

Now, the greatest use of the credit by large corporations did not come as a surprise to us since those corporations typically would be ones that would have more extensive research and experimentation programs with relatively greater resources to devote to R&E.

One of the things that we did find that was interesting and we thought positive was that there were basically four industry categories in which most of the R&E credits were claimed and that a high percentage of the claimed credits were indeed being claimed in industries which would be typically associated with high technology.

In tables that have been attached to our written statement we detail those industries and amounts of the credits claimed by those industries.

In connection with the growth of R&E expenditures, our data for 1981 indicated that corporate taxpayers reported an average growth rate in research and experimentation expenditures from the pre-1981 period to 1981 of 40.3 percent.

Twenty percent of the corporate returns with tentative R&D credits reported growth rates in R&E in excess of 200 percent and an additional 18 percent reported growth rates between 100 and 200 percent.

For the most part, the industries reporting relatively high increases in R&E expenses received a relatively small fraction of all R&E credits averaging less than 2 percent each of the total tentative credits.

The growth in qualifying expenditures was greater for smaller corporations than larger corporations. In 1981, for example, qualifying expenditures increased by 104.5 percent for corporations with assets between $1 million and $10 million compared to an increase of only 32.2 percent for corporations with assets greater than $10 million.

Although the 1982 data do not reflect the returns of very large corporations, preliminary indications are of a substantial increase in R&E expenses over 1981, although we suspect that when the final data are in, the increases will be somewhat less than the increase in 1981.

Data relating to the growth of R&E expenditures obviously are critical in trying to determine whether the credit is effective and whether it is indeed performing its objective in encouraging these expenditures.

The preliminary indication of substantial growth recorded by taxpayers does not at this time support firm conclusions about the effectiveness of the credit. The increase in expenses reported by taxpayers may indeed have come from the credit and we presume indeed that the credit has had some intended incentive effect.

But it may also be that some of that increase came simply because taxpayers have had to reclassify costs as R&E in order to claim the R&E credit. Thus, significant conclusions about the credit's effectiveness as a spur to innovation simply must await collection of data for a larger number of years.

Careful scrutiny of the credit and its effect on R&E expenditures also must take into account that the actual incentives supplied by the credit will vary among different taxpayers.

The credit will be of maximum value only to taxpayers who have current tax liabilities against which to offset the credit or tax liabilities from prior years' gains which the credit could be carried.

For 1981 we estimate that taxpayers were not able to utilize approximately 23 percent of the tenative credits against 1981 tax liability or liabilities for previous years. Of course taxpayers will be able to utilize those credits to the extent they do have tax liability in years subsequent to 1981, and again our data as it develops for subsequent years will give us a feel as to the extent to which those credits actually were utilized.

As I indicated, Mr. Chairman, because we believe that the data is not complete and that although the data do show an increase in R&E expenses and may indeed indicate that the credit is having an incentive effect, we are supportive of extending the R&E credit beyond its current expiration date of December 1985 as part of the administration's general support of research and experimentation.

Given our large limited experience, however, we would oppose, we opposed and we will continue to oppose, making the credit permanent at this time. Additional experience will enable us to make informed judgments, we believe, about the effectiveness of the credit.

Current information simply is inadequate to do that. Although we favor extending the credit, we believe that as part of any extension, the range of expenses eligible for the credit must be reexamined.

In our view, the current definition of qualifying expenses does not adequately target the credit for innovative R&E activities. The imprecision of current law has permitted taxpayers unwarranted flexibility in classifying costs as R&E expenses.

The definition of qualifying expense for purposes of credit must not only identify those innovative R&E activities that merit Government support, but must incorporate sufficient subjective standards for taxpayers to plan their activities with reasonable certainty as to the credit's availability.

We begin with the proposition that all costs incurred in conducting basic research should be creditable. However, the definition of R&E should continue to exclude basic research, as it does today, in social sciences or humanities or basic research conducted outside the United States.

In identifying expenses for commercial research that should receive the credit, we believe as a first principle that research entitled to the credit must be designed to produce a significant technological improvement in a business component.

A useful definition incorporating that principle can be found in the Senate amendment in H.R. 4170, the Deficit Reduction Act of 1984.

Although the conferees agreed to defer consideration of the R&E credit, the Senate definition does in fact target technological innovation and provides taxpayers with relatively objective rules.

The Senate concluded that the definition derived from section 174 is too broad. The new definition was developed by the Senate Finance Committee in consultation with representatives of Treasury and industry and we believe that this joint effort did in fact result in a definition which responds both to our concerns that the credit be targeted to R&E activities relating to technological innovation and industry's desire for definition with relatively objective standards.

Under the Senate definition, a business component is technologically new and improved if the new and improved characteristic of the component is technological in nature and substantially all the development activities involve a process of experimentation relating to functional, rather than stylistic, aspects of the component.

This requirement is designed to exclude nontechnological activities such as the development of financial products or activities relating to the provision of services.

The term "business component" is designed to focus on the particular components of a product to which the R&E activities relate. This will prevent routine product development cost from qualifying for the credit.

In order to exclude from the credit activities that would not, by their nature, result in technological innovation, the Senate definition also denies the credit for certain activities regardless of whether a new or improved business component is involved. This exclusion is designed, among other things, to prevent costs incurred in reverse engineering from qualifying for the credit.

In addition, the Senate definition specifically excludes activities relating to the adaptation of existing products to particular requirements of one customer and provides that any costs incurred with respect to business components after the beginning of commercial production are not eligible for the credit. We believe this exclusion is intended and will have the effect of preventing costs associated with certain postresearch activities such as debugging or retooling from qualifying for the credit.

We think the Senate definition is an important effort to improve the effectiveness of the credit. It more precisely targets the credit to innovative R&E activities while providing taxpayers with objective standards for the credit's availability.

In addition to the definition of qualifying R&E expenses, we think there are certain other issues relating to the credit which should be considered as part of the subcommittee review of the credit. Some of these issues were addressed in the Senate amendment.

In connection with startup companies, current law provides that R&E credit is available in connection with qualifying amounts paid or incurred in connection with the carrying on of any trade or business of the taxpayer.

This requirement is intended to serve two purposes.

First, it prevents tax shelters from receiving the benefit of the credit by denying to entities conducting research and development for others.

Second, serves to protect the incremental feature of the credit.

We think it is very important that an extension of credit retain the requirement that the R&E expenses or credit will only be allowed in connection with an ongoing trade or business. The Senate amendment did adopt a special rule for corporate taxpayers designed to address in part the availability of the credit for startup companies.

In certain cases, new corporations or corporations beginning a new line of business cannot claim the credit under current law for qualifying R&E expenses because the expenses do not relate to an ongoing trade or business.

Under the Senate amendment any corporation other than a corporation, personal holding company or personal service corporation would be able to claim the credit if it intends to use the results of the research in active conduct of present or future trade or business.

This approach would continue the current law's denial of the credit to taxpayers which merely lease or license research results, but would extend the credit to research expenses to true startup corporations not engaged in trade or business or an existing corporation entering a new business.

We think this modification is a worthwhile change in the credit.

The credit currently has an incremental aspect; that is, the credit is only available to the extent that qualifying expenses exceed the average of expenses over the 3 previous years.

In addition, the credit has a limit on it which in effect says that the credit for expenses cannot exceed 50 percent of the taxpayer's qualifying expenses for the current year.

We recognize that the base period limit on qualifying expenses under the incremental requirement makes the true value of the credit dependent on the relative growth or decline in the taxpayer's expenses from one year to another.

For example, for firms which have a growth rate of somewhere between zero and 100 percent over the base period, the credit will provide a full 25-percent tax benefit.

On the other hand, if the growth rate increases over 100 percent, the 50-percent cap will gradually reduce the tax benefit from 25-percent benefit to as little as 12½ percent. The base period limitation is appropriately intended, however, to target the credit to new or additional R&E expenses.

Although the limit may introduce, as I have indicated, some disparities in the incentive effect of the credit, we continue to support the incremental focus of the credit and believe the base period limitation should be retained if the credit is extended.

In addition, it might be desirable to refine the base period limit to assure that the incremental focus is not eroded by inflation.

In an inflationary period a portion of additional R&E expenses will be attributable to inflation rather than to real increases in the level of R&E activity. We think it might be appropriate to consider whether a taxpayer's base period expenses should be indexed to account for the effect of inflation. In this way the credit would be provided only for real increases in R&E expenses.

In connection with university basic research, Mr. Chairman, we oppose creating a separate credit for contributions to universities to conduct basic research as was proposed in the Senate amendment.

However, although we do not favor creating additional incentives for contributions for research through a separate credit, we do believe the committee should examine whether the current structure of credit discourages corporations from entering into commitments with universities to fund multiyear basic research projects.

A straightforward change in the law could remove the potential effect under current law that limits these multiyear grants by corporations and other businesses to universities. Such an approach would prvoide that the total research ad experimentation credit allowed with respect to a binding multiyear funding commitment to a university would not be reduced below the amount of the credit that would have been available had the company made the contribution in only 1 year.

Of course, we would not be in favor of allowing the credit until the contribution actually was made.

In conclusion, Mr. Chairman, the administration does continue to support the R&E credit, believing it can provide an important incentive to the innovative activities that are critical to these companies' economic future.

In order to make the credit accomplish that objective in the most efficient method possible, the definition of qualifying expenses should be modified so as to target the credit to innovative research activities.

We look forward to working with the subcommittee to improve and extend the credit. We appreciate the opportunity to offer our comments.

[The prepared statement follows:]

STATEMENT OF RONALD A. PEARLMAN, ACTING ASSISTANT SECRETARY (TAX POLICY), DEPARTMENT OF THE TREASURY

Mr. Chairman and members of the subcommittee, I am pleased to have the opportunity to present the views of the Administration on the tax credit for certain research and experimental ("R&E") expenses. The need for and the appropriate form of the R&E credit is a matter of continuing interest to the Administration, and an inter-agency working group has been established to study various aspects of the credit. My testimony today will summarize our current views based on the data available at the present time.

In its press release announcing these hearings, this Subcommittee raised several issues regarding the R&E credit that are of interest to the Administration. The press release focused on the effectiveness of the present credit in terms of Congress' original intention to provide an incentive for technological innovation. We believe that the central question with respect to the R&E credit's effectiveness is whether the definition of expenses qualifying for the credit has been drawn so as to target the credit most efficiently.

The Administration remains committed to the R&E credit and favors extending it for an additional three years through December 31, 1988. As part of any extension of the R&E credit, however, we strongly support tying the credit more closely to those private R&E activities that are likely to result in technological innovations. With a more carefully drawn definition of qualifying expenses, the R&E credit can provide an important incentive for taxpayers to undertake essential R&E.

I would like to note that my testimony will not touch upon certain topics typically associated with the R&E credit, such as the enhanced charitable deduction for certain contributions of property to universities. As we have indicated in previous testimony, the Treasury Department has strong opinions regarding the types of property which would be eligible for this enhanced deduction.

I. BACKGROUND

Objectives of the credit

The Administration is determined to encourage continued growth of domestic R&E activity. The technological invocation necessary to the long-term vitality of the American economy will come only from a substantial commitment to R&E. Without that commitment, our competitive position in the world economy will inevitably decline.

The term "R&E" in ordinary usage describes a broad variety of research activities by commercial as well as non-profit organizations. Thus, R&E embraces both basic research, i.e., research tied to general scientific, rather than specific, commercial objectives, and research activities for commercial product development. Broad government support of R&E is particularly essential in the area of basic research, which, by its nature, cannot be expected to be self-supporting. Although the scientific and technological advances from basic research ultimately may prove to have commercial applications, such applications are typically too remote to permit private investors profitably to support the research. For this reason, the Federal government has traditionally taken a lead role in funding basic research, primarily through grants to universities and other non-profit organizations.

Government support of R&E also is appropriate with respect to certain forms of research with direct commercial applications. A business will invest in R&E only to the point that the expected commercial returns are at least equal to that available from alternative investments. Although opportunities for commercial profit ordinarily may reflect society's desired allocation of resources, the return to the private investor from R&E expenditures may not reflect society's true benefit from resulting innovation. If a business invests a new type of product, or "builds a better mousetrap," imitators will appear and share the profits to be realized from this innovation. This will occur in many cases despite the fact that a business patents a new product or attempts to keep an innovative process secret. To the extent the investor does not fully capture the commercial returns from technological innovation, businesses may spend less than optimal amounts for R&E. Where market rewards for R&E expenditures do not match society's need for technological innovation, it falls appropriately upon government to supply additional incentive.

Existing law

The federal income tax system currently provides two incentives for qualifying R&E expenditures. Section 174 allows a taxpayer to deduct currently "research or experimental" expenses incurred in connection with the taxpayer's trade or business. The expensing election permitted by section 174 is an exception to the general rule that a taxpayer must capitalize costs incurred to develop an asset which has a useful life that extend beyonds the taxable year.

In addition to the expensing election of section 174, section 44F allows a 25 percent tax credit for a certain portion of a taxpayer's "qualified research expenses." Creditable expenses include qualified R&E expenditures made directly by the taxpayers as well as 65 percent of the amount expended for contract research, and, in the case of corporate taxpayers, 65 percent of the amount contributed to universities and other qualifying organizations for research purposes.

The portion of a taxpayer's qualified R&E expenses that are eligible for the credit is limited to the lesser of (1) the excess of such expenses in the current year over the average amount of such expenses for the prior three-year period, or (2) 50 percent of qualified R&E expenses in the current year. Taxpayers may carry credits not usable in the current year back for three years and forward for fifteen.

Section 44F defines "qualified research" expenditures by reference to the term "research or experimental" under section 174. The legislative history of the R&E credit further indicates that the existing administrative interpretations under section 174 were also to apply for purposes of section 44F. Treasury regulations under section 174 define the term "research or experimental expenditures" to mean "research and development costs in the experimental or laboratory sense" and include costs incurred to develop an "experimental or pilot model, a plant process, a product, a formula, an invention, or similar property." The regulations exclude from that definition costs incurred "for the ordinary testing or inspection of materials or products for quality control or those for efficiency surveys, management studies, consumer surveys, advertising, or promotion." Regulations proposed under section 174 subsequent to the enactment of section 44F also would exclude routine, periodic or cosmetic alteration or improvement of existing products, planning for commerical production and trial production runs, engineering follow-through or troubleshooting during commerical production and the adaptation of an existing product to a particular customer's requirements.

The current regulations under section 174 do not precisely identify the type of expenses qualifying as "research or experimental." Under section 174, this lack of precision may not be critical, since many expenditures are deductible currently either as R&E expenses or as ordinary and necessary business expenses under section 162. The same imprecision in the definition of qualifying expenses is not acceptable for purposes of the credit, however, since it enables taxpayers to argue that virtually all preproduction costs associated with developing any product or process qualify for the credit. A definition which fails to focus on innovative R&E activities effectively dilutes the incentive for taxpayers to undertake innovative R&E.

II. EXPERIENCE WITH THE CREDIT

Our experience with the credit is limited to 1981 and preliminary 1982 data. This data is presented in detail in the attached tables, and I will touch only on its highlights. At the outset, let me caution against drawing firm conclusions based on our experience over this limited period of time. We have only partial tax return data for 1982 and the data for 1981, though complete, represent only six months experience with the credit.

Use of the credit

The available data does suggest that the R&E credit was claimed primarily by large corporations. The 12,000 corporate taxpayers claiming the credit in 1981 represented about 39 percent of total corporate assets and receipts, but less than one percent of all corporations filing 1981 returns. In the groups of corporations with assets of $10 billion or more, 70.2 percent (74.8 percent of total assets) had tentative credits, compared to 2.8 percent of corporations (with 3.7 percent of assets) with assets between $1 million and $10 million. The greater use of the R&E credit by large corporations is not surprising since such corporations would typically have more extensive R&E programs with relatively greater resources to devote to R&E.

The data also indicate that the corporations claiming the R&E credit were concentrated in a few industries. Corporations in four industry categories—metals and machinery, chemicals, motor vehicles and transportation, communications and utilities—accounted for more than three-fourths of qualifying R&E expenditures in 1981. As indicated in Table 2, these corporations account for less than one-half of total receipts of all corporations with tentative credits.

Within these four broad industry categories, businesses in fields typically associated with high technology (see Table 9) accounted for a major share of the reported

R&E expenses. These corporations accounted for 44 percent of all qualifying R&E expenditures, but only 12 percent of total receipts of all corporations with tentative credits.

Growth in R&E expenditures

Corporate taxpayers reported an average growth rate in R&E expenditures of 40.3 percent in 1981. Twenty percent of corporate returns with tentative R&E credits reported growth rates in R&E greater than 200 percent and an additional 18 percent reported growth rates between 100 and 200 percent. Three industries reported growth in qualifying R&E expenditures exceeding 100 percent. The highest reported growth rates were 125 percent in services, 177 percent in contract construction, 111 percent in paper and printing, 86 percent in petroleum refining and 81 percent in trade. For the most part, however, the industries reporting relatively high increases in R&E expenses received a relatively small fraction of all R&E credits, averaging less than two percent each of the total tentative credits.

The growth in qualifying expenditures was greater for smaller corporations than for large corporations. In 1981, for example, qualifying R&E expenditures increased by 104.5 percent for corporations with assets between $1 million and $10 million, compared to an increase of 32.2 percent for corporations with assets greater than $10 billion. (See Tables 7 and 8).

Although tax return data for 1982 still do not reflect the returns of a number of very large corporations, preliminary indications are of a substantial increase in R&E expenditures over 1981. The average rate of growth in R&E expenditures may have slowed in 1982, however, the preliminary data indicating a decline from 40 to 38 percent. The final figures may indicate a more substantial drop, since the current data does not reflect the returns for larger corporations which we would expect to report lower than average rates of growth. Only R&E expenses in the services industry continued to grow at a rate in excess of 100 percent.

Data relating to the growth in R&E expenditures are obviously of critical interest, given the objective of the credit to encourage such expenditures. The preliminary indications of substantial growth in R&E expenditures reported by corporate taxpayers do not at this point, however, support firm conclusions about the effectiveness of the credit in promoting R&E. The increased R&E expenses reported by taxpayers may indicate that the credit is having the intended incentive effect, but it may also be that taxpayers have simply reclassified costs as R&E expenses in order to claim the R&E credit. Significant conclusions about the credit's effectiveness as a spur to technological innovation must await the collection of data from a number of years.

Credit limitations

Careful scrutiny of the credit's effect on R&E expenditures must also take into account that the actual incentive supplied by the credit will vary among different taxpayers. The credit will be of maximum value only to those taxpayers which have a current tax liability or tax liabilities for prior years against which the credit could be carried back. For 1981, we estimate that taxpayers were not able to utilize approximately 23 percent of tentative credits either against 1981 tax liability or liabilities for the three previous years. Of course, taxpayers unable to utilize R&E credits fully in 1981 would be allowed to carry such credits forward for 15 years to apply against future years' tax liabilities.

III. EXTENSION OF CREDIT

The R&E credit is currently scheduled to expire on December 31, 1985. The Administration continues to support the R&E credit and favors its extension. Given our limited experience with the credit, however, and the uncertainty of the preliminary data, we oppose making the credit permanent at this time. Additional experience with the credit will enable us to make informed judgments about the credit's effectiveness in promoting technological innovation. The data currently available is simply inadequate to that task. In the meantime, we favor extending the R&E credit for an additional three years.

Definition of qualifying R&E expenses

Although the Administration favors extending the R&E credit, we believe that as part of any such extension the range of expenses eligible for the R&E credit must be reexamined. In our view, the current definition of qualifying expenses does not adequately target the credit toward innovative R&E activities. The imprecision of the current law definition has permitted taxpayers unwarranted flexibility in classifying business costs as R&E expenditures.

The definition of qualifying expenses for purposes of the R&E credit must not only identify those innovative R&E activities which merit government support, but must also incorporate sufficiently objective standards for taxpayers to plan their activities with reasonable certainty about the credit's availability. A definition which satisfies these two criteria will more effectively encourage taxpayers to undertake innovative R&E activities.

We begin with the proposition that all costs incurred in conducting basic research should be creditable. The term basic research includes any original investigation for the advancement of scientific knowledge not having a specific commercial objective. For purposes of the credit, however, such term should continue to exclude basic research in the social sciences or humanities or basic research conducted outside the United States.

In identifying the expenses for commercial research that should receive the credit, we believe as a first principle that research entitled to the credit must be designed to produce a significant technological improvement in a business component. A useful definition incorporating that principle can be found in the Senate amendment to H.R. 4170 (the "Senate definition"). Althouth the conferees agreed to defer consideration of the R&E credit, the Senate definition targets technological innovation and provide taxpayers with relatively objective rules.

The Senate concluded that the definition derived from section 174 is too broad for purposes of the credit and allows taxpayers to claim the credit for virtually all preproduction expenses. The new Senate definition was developed by the Senate Finance Committee in consultation with Treasury and industry representatives. We believe that this joint effort resulted in a definition which responds both to our concerns that the credit target R&E activities leading to technological innovation and to industry's desire for a definition with relatively objective standards.

Under the Senate definition, a business component is "technologically new or improved" if the new or improved characteristics of the business component are technological in nature and substantially all of the development activities involve a process of experimentation relating to functional rather than stylistic, aspects of the business component. For this purpose, the term "technological" means activities pertaining to or predicated upon principles of the physical or biological sciences, or engineering or computer science. This requirement is designed to exclude non-technological activities, such as the development of financial products or activities relating to the provision of services.

The phrase "process of experimentation" generally is designed to encompass the evaluation of alternatives that involve a serious degree of uncertainty as to whether the desired result would be achieved. Experimentation does not include trial and error techniques where the method of reaching the desired objective is readily discernible.

In this context, the term "business component" means the most basic element or component part of a product or process with respect to which the R&E activities relate. If the R&E activities relate to an entire product or process, then the development costs for the entire product are creditable. On the other hand, if the R&E activities relate only to a component part and the taxpayer incurred more than an insignificant amount of non-R&E development costs with respect to other aspects of the product or process, only the R&E costs related to the component will be eligible for the credit. Focusing on the particular component to which the R&E activities relate will prevent routine product development costs from qualifying for the R&E credit.

In order to exclude from the credit activities that would not by their nature result in technological innovation, the Senate definition also denies the credit for certain activities regardless of whether a new or improved business component is involved. Thus, the Senate definition excludes the costs of developing a business component if the predominant portion of the development costs is made up of duplication expenditures. Duplication is defined as any activity related to the reproduction of an existing business component from examining the component or from examining plans, blueprints, detailed specifications or publicly available information. This exclusion is designed, among other things, to prevent costs incurred in "reverse engineering" from qualifying for the credit.

In addition, the Senate definition specifically excludes activities relating to the adaptation of an existing product to the particular requirements of one customer. It also provides that any costs incurred with respect to a business component after the beginning of commercial production are not eligible for the credit. For this purpose, the term "beginning of commercial production" refers to the point where the business component meets the taxpayer's basic functional and economic requirements or is ready for commercial sale or use. This exclusion is intended to prevent costs associated with certain port-research activities, such as debugging or retooling, from qualifying for the credit.

The Senate definition continues the current law's exclusion for research (1) conducted outside the United States, (2) in the social sciences, arts or humanities, or (3) funded by any grant, contract or otherwise, and for costs associated with ascertaining the existence, location, extent or quality of any deposit of ore or other mineral (including oil and gas). In addition, the definition excludes costs associated with efficiency surveys, management studies, management techniques, market research, market tests and quality control.

In summary, the Senate definition is an important effort to improve the effectiveness of the R&E credit. It more precisely targets the credit to innovative R&E activities while providing taxpayers with relatively objective standards for the credit's availability.

Collateral R&E credit issues

In addition to the definition of qualifying R&E expenses, we suggest that certain other issues relating to the credit be considered as part of this review of the R&E credit. Some of these issues were addressed in the Senate amendment.

Start-up companies.—Current law provides that the R&E credit is available in connection with qualifying amounts paid or incurred in carrying on any trade or business of the taxpayer. This requirement is intended to serve two related purposes. First, it prevents tax shelters from receiving the benefit of the credit by denying it to entities conducting research and development for third parties. Second, it serves to protect the incremental feature of the credit: if any taxpayer could receive the credit, existing businesses would avoid the base period limitation by having research performed by other entities which had no base period R&E. We support retention of the requirement that R&E expenses are creditable only if incurred in connection with an ongoing trade or business.

The Senate amendment, however, adopted a special rule for corporate taxpayers designed to address, in part, the availability of the credit to start-up companies. In certain cases, new corporations and corporations beginning a new line of business can not claim the credit for qualifying R&E expenses because the expenses do not relate to an ongoing trade or business. Under the Senate amendment, any corporation, other than an S corporation, personal holding company or service organization, may claim the credit without regard to the trade or business test if the taxpayer intends to use the results of the research in the active conduct of a present or future trade or business. This approach would continue current law's denial of the credit to taxpayers which merely lease or license research results, but would extend the credit to research expenses of a start-up corporation not yet engaged in a trade or business or of an existing corporation entering a new business. We believe that such a modification of the trade or business requirement is worthwhile.

Incremental aspect of the credit.—Section 44F allows a 25 percent credit on a taxpayer's qualifying R&E expenses in excess of the average amount of such expenses during the three previous taxable years. Creditable expenses may not, however, exceed 50 percent of the taxpayer's qualifying R&E expenses for the current year. The base period limitation on qualifying R&E expenses makes the true value of the credit dependent on the relative growth or decline in the taxpayer's R&E expenses. For firms with a growth rate in qualifying R&E expenditures of between 0 and 100 percent, the credit provides a full 25 cent tax benefit for every dollar increase in R&E expenditures. On the other hand, as a firm's growth rate for R&E expenditures moves in excess of 100 percent, the 50 percent cap will gradually reduce the tax benefit from 25 cents to as little as 12.5 cents for every additional dollar expended. Moreover, due to the base period limitation, the credit provides no incentive for corporations with declining R&E expenditures to reduce their rate of decline.

The base period limitation on the R&E credit is appropriately intended to target the credit to new or additional R&E expenditures. Although the base period limitation may introduce some disparities in the incentive effect of the credit, we continue to support the incremental focus of the credit and believe that the base period limitation should be retained.

In addition, it may be desirable to refine the base period limitation to ensure that its incremental focus is not eroded by inflation. In an inflationary period, a portion of additional R&E expenditures will be attributable to inflation rather than to real increases in the level of R&E activity. A business that incurs qualified research expenses in year 1 and increases its costs in subsequent years only to keep pace with increased costs would receive an R&E credit even though it would have no real increase in R&E expenditures. We think it is appropriate to consider whether a taxpayer's base period research expenses should be indexed to account for the effect of inflation. In this way, the credit would be provided only for real increases in R&E expenditures.

University basic research.—Under current law, 65 percent of amounts which a corporation contributes to universities and certain other qualifying organizations to conduct basic research are treated as qualified research expenses eligible for the credit. We believe this aspect of the current R&E credit provides an important incentive for taxpayers to make contributions to fund university basic research and should be retained. However, we oppose creating a separate credit for contributions to universities to conduct basic research, as was proposed in the Senate amendment.

Although we do not favor creating additional tax incentives for contributions to universities for basic research, we believe the Committee should examine whether the current structure of the credit discourages corporations from entering into commitments with universities to fund multi-year basic research projects. As noted above, under current law the effective R&E credit available to a company that makes a multi-year funding commitment is much smaller than that available if the same funds are paid in a single year. A straight-forward change in the law could remove the effect that this aspect of the credit has on university contributions. It would provide that the total R&E credit allowed with respect to a binding multi-year funding commitment to a university would not be reduced below the amount of the credit that would have been available had the company made the contribution all in one year. Of course, the credit would not be allowed until the contribution was actually made.

IV. CONCLUSION

The Administration continues to support the R&E credit, believing that it can provide an important incentive to the innovative R&E activities that are critical to this country's economic future. In order that the credit accomplish that objective in the most efficient manner possible, the definition of qualifying expenses should be modified so as to target the credit to innovative R&E activities. We look forward to working with the Subcommittee to improve and extend this important provision.

TABLE 1.—CORPORATIONS WITH TENTATIVE RESEARCH AND EXPERIMENTATION CREDITS AND AS A PERCENTAGE OF ALL CORPORATIONS BY INDUSTRY IN 1981

[Dollar amounts in millions]

Industry	Corporations with credits					
	Number	Percentage of total	Assets employed		Receipts	
			Amount	Percentage of total	Amount	Percentage of total
Agriculture, forestry, and fisheries	152	0.18	$2,725	6.5	$7,065	11.6
Mining	14	0.30	6,585	23.6	4,479	19.5
Crude petroleum and gas	123	0.43	45,310	41.0	30,926	18.6
Contract construction	188	0.07	13,469	12.6	18,301	6.8
Food and tobacco	355	2.15	87,274	60.5	141,749	47.6
Textile, apparel, and leather	275	1.15	10,564	25.8	22,834	21.4
Paper and printing	201	0.55	13,856	31.8	20,722	26.8
Petroleum refining	36	4.03	288,145	85.7	575,902	87.2
Chemicals and rubber	1,021	4.70	155,920	81.7	189,057	74.8
Lumber, furniture, stone, clay, and glass	456	1.31	65,941	53.5	80,406	45.6
Metals and machinery	3,562	4.15	299,786	67.6	386,116	62.5
Transportation equipment	213	4.63	25,155	53.7	38,992	57.7
Motor vehicles	117	3.71	74,339	80.9	116,042	78.8
Transportation, communication, and utilities	2,402	0.75	539,924	55.4	428,006	33.6
Trade	683	0.11	79,114	21.9	210,371	15.2
Finance, insurance, and real estate	423	0.09	693,786	22.8	107,547	32.5
Services	2,128	0.28	22,938	13.0	30,448	9.3
Other	32	0.18	15	0.7	40	0.9
Total	12,384	0.44	2,424,847	38.4	2,409,006	38.6
All corporations	2,812,420	100.00	6,303,262	100.0	6,244,678	100.0

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 26, 1984.

TABLE 2.—QUALIFIED RESEARCH AND EXPERIMENTATION EXPENDITURES AND TENTATIVE CREDITS EARNED BY CORPORATIONS BY INDUSTRY IN 1981

[Dollar amounts in millions]

Industry	Receipts [1]	Qualified expenditures			1981 tentative credit	Percentage of all tentative credits
		1981	Base period [2]	1981 growth [percent]		
Agriculture, forestry and fisheries	$7,065	$24.6	$17.3	41.9	$1.7	0.2
Mining	4,479	8.2	4.9	68.2	0.7	0.1
Crude petroleum and gas	30,926	127.3	71.9	77.2	12.3	1.4
Contract construction	18,301	24.8	11.4	117.3	2.6	0.3
Food and tobacco	141,749	314.6	231.9	35.7	20.2	2.3
Textile, apparel and leather	22,834	65.1	39.6	64.1	5.2	0.6
Paper and printing	20,722	53.7	25.5	110.8	5.6	0.6
Petroleum refining	575,902	782.7	420.7	86.0	73.8	8.5
Chemicals and rubber	189,026	2,210.2	1,681.6	31.4	131.3	15.1
Lumber, furniture, stone, clay and glass	80,407	408.1	301.1	35.6	25.6	2.9
Metals and machinery	386,020	4,920.4	3,613.3	36.2	297.7	34.1
Transportation equipment	38,992	523.9	396.0	32.3	29.5	3.4
Motor vehicles	116,042	1,416.1	1,162.0	21.9	63.1	7.2
Transportation, communication and utilities	426,995	1,848.2	1,233.0	49.9	134.8	15.5
Trade	210,247	125.1	69.2	80.7	11.4	1.3
Finance, insurance and real estate	107,547	292.3	172.1	69.8	25.5	2.9
Services	30,437	294.1	130.7	124.9	31.2	3.6
Other	40	0.6	0.4	59.2	0.1	([3])
Total all corporations	2,407,731	13,440.1	9,582.7	40.3	872.1	100.0

[1] For corporations with tentative credits.

[2] Base period adjusted to reflect same number of months as in qualified tax year ending after June 30, 1981.

[3] Less than 0.05 percent.

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 26, 1984.

TABLE 3.—SHARES AND GROWTH RATES OF CATEGORIES OF QUALIFIED R&E EXPENDITURES FOR CORPORATIONS WITH TENTATIVE CREDITS BY INDUSTRY IN 1981

[In percent, dollar amounts in millions]

Industry	Total qualified expenditures	Wages		Supplies		Rental and lease costs		Contract research expense		University contracts	
		Share	Growth rate	Share	Growth rate	Share	Growth rate	Share	Growth rate	Share	Growth rate
Agriculture, forestry and fisheries	$24.6	50.8	36.6	34.9	41.5	3.2	96.6	10.6	52.3	0.6	465.7
Mining	8.2	63.8	35.3	20.7	298.0	2.1	127.8	10.5	104.9	2.9	175.8
Crude petroleum and gas	127.3	80.8	64.6	9.9	135.7	1.0	89.8	6.7	265.2	1.6	106.3
Contract construction	24.8	62.2	107.2	11.9	172.7	4.3	118.0	13.8	187.8	7.9	60.4
Food and tobacco	314.6	76.2	25.4	12.1	58.6	3.9	137.2	6.9	114.1	0.8	108.6
Textile, apparel and leather	65.1	70.4	50.3	20.5	82.9	2.2	99.9	6.3	277.1	0.6	360.7
Paper and printing	53.7	70.5	99.1	15.1	131.3	4.5	257.0	8.2	122.3	1.7	212.4
Petroleum refining	782.7	65.3	95.7	16.0	74.5	3.8	59.6	14.3	68.1	0.5	81.1
Chemicals and rubber	2,210.2	67.6	23.6	23.0	49.4	1.3	51.4	6.4	57.6	1.6	56.7
Lumber, furniture, stone, clay and glass	408.1	82.5	31.8	13.2	53.3	1.2	57.8	2.8	76.3	0.2	58.4
Metals and machinery	4,920.4	72.5	30.8	21.2	50.4	2.0	35.1	3.9	75.0	0.4	111.5
Transportation equipment	523.9	63.8	26.4	28.9	33.1	1.2	50.6	5.7	132.9	0.4	112.4
Motor vehicles	1,416.1	61.6	12.1	29.8	38.6	2.4	27.3	6.1	67.3	0.1	98.2
Transportation, communication and utilities	1,848.2	68.8	45.5	16.9	60.1	3.2	72.3	8.1	69.7	3.0	33.9
Trade	125.1	70.0	68.5	9.2	102.0	7.9	79.6	11.8	152.2	1.2	490.9
Finance, insurance and real estate	292.3	68.8	60.5	10.2	67.1	7.9	85.8	11.6	126.9	1.5	170.3
Services	294.1	74.6	122.8	11.7	178.3	4.7	2.5	6.8	254.5	2.3	615.5
Other	0.6	100.0	59.2	0.0	(1)	0.0	(1)	0.0	(1)	0.0	(1)
Total	13,440.1	69.6	34.3	20.7	51.1	2.4	50.0	6.2	77.9	1.0	64.6

[1] No expenditures in this category.

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 26, 1984.

TABLE 4.—APPARENT INABILITY TO CLAIM RESEARCH AND EXPERIMENTATION CREDITS IN YEAR EARNED DUE TO INADEQUATE TAX LIABILITY FOR CORPORATIONS WITH QUALIFIED EXPENDITURE GROWTH RATES UNDER 100 PERCENT BY INDUSTRY IN 1981

Industry	By number of returns				By total assets				By amount of tentative credit			
	Total	Percent with—			Total (millions)	Percent with—			Total (thousands)	Percent with—		
		Full use	Partial use	No use		Full use	Partial use	No use		Full use	Partial use	No use
Agriculture, forestry and fisheries	72	21.5	78.5	0.0	$1,134	46.1	53.9	0.0	$1,600	20.9	79.1	0.0
Mining	9	66.7	0.0	33.3	5,653	84.0	0.0	16.0	360	79.9	0.0	20.1
Crude petroleum and gas	73	40.2	0.0	59.8	38,281	32.2	0.0	67.8	9,185	90.2	0.0	9.8
Contract construction	40	59.9	40.1	0.0	1,219	21.1	78.9	0.0	1,500	83.6	16.4	0.0
Food and tobacco	195	56.2	7.3	36.5	81,172	89.8	5.0	5.2	19,114	62.6	12.7	24.8
Textile, apparel and leather	123	88.2	11.8	0.0	7,229	90.4	9.6	0.0	3,088	96.1	3.9	0.0
Paper and printing	39	86.9	0.0	13.1	8,097	96.5	0.0	3.5	2,181	94.9	0.0	5.1
Petroleum refining	24	74.8	0.0	25.2	281,916	95.0	0.0	5.0	72,027	99.1	0.0	0.9
Chemicals and rubber	576	73.8	3.2	23.0	151,984	68.4	13.6	18.0	125,441	65.0	18.6	16.3
Lumber, furniture, stone, clay and glass	226	75.9	7.3	16.8	58,726	47.7	1.7	50.7	23,130	81.2	0.9	17.8
Metals and machinery	1,589	66.5	5.9	27.7	272,339	63.4	10.5	26.1	240,013	62.6	16.5	21.0
Transportation equipment	79	68.0	0.0	32.0	21,894	47.0	0.0	53.0	21,786	67.4	0.0	32.6
Motor vehicles	77	64.9	1.3	33.7	73,764	67.9	0.0	32.1	62,553	57.7	0.0	42.2
Transportation, communication and utilities	716	77.5	1.7	20.8	469,767	84.6	0.3	15.2	103,725	89.1	2.1	8.8
Trade	182	63.8	3.2	33.0	44,105	67.1	12.4	20.5	5,669	78.3	5.7	16.0
Finance, insurance and real estate	162	58.0	1.2	40.8	530,768	64.2	1.6	34.2	15,558	56.8	2.6	40.5
Services	196	68.4	31.6	0.0	13,220	93.4	6.6	0.0	10,441	73.5	26.5	0.0
Others	32	100.0	0.0	0.0	15	100.0	0.0	0.0	55	100.0	0.0	0.0
Total	4,412	68.8	7.1	24.2	2,072,254	73.4	3.9	22.7	717,425	71.5	10.2	18.3

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 26, 1984.

TABLE 5.—APPARENT INABILITY TO CLAIM RESEARCH AND EXPERIMENTATION CREDITS IN YEAR EARNED DUE TO INADEQUATE TAX LIABILITY FOR CORPORATIONS WITH QUALIFIED EXPENDITURE GROWTH RATES IN EXCESS OF 100 PERCENT BY INDUSTRY IN 1981

Industry	By number of returns				By total assets				By amount of tentative credit			
	Total	Percent with—			Total (millions)	Percent with—			Total (thousands)	Percent with—		
		Full use	Partial use	No use		Full use	Partial use	No use		Full use	Partial use	No use
Agriculture, forestry and fisheries	80	36.8	36.2	0.0	$1,592	10.3	89.7	0.0	$139	38.3	60.7	0.0
Mining	5	0.0	0.0	100.0	932	0.0	0.0	100.0	324	0.0	0.0	100.0
Crude petroleum and gas	50	40.1	7.7	52.2	7 029	50.6	0.7	48.6	3,068	56.2	8.0	35.8
Contract construction	148	60.8	39.2	0.0	1,279	84.0	16.0	0.0	1,080	52.1	47.9	0.0
Food and tobacco	159	72.2	3.8	24.0	6,101	76.3	1.2	22.5	1,043	67.9	8.2	24.0
Textile, apparel and leather	152	81.2	18.8	0.0	3,336	80.0	20.0	0.0	2,159	78.4	21.6	0.0
Paper and printing	161	78.0	9.2	12.8	5,760	90.3	7.1	2.6	3,425	70.2	25.9	3.8
Petroleum refining	12	0.0	0.0	100.0	6,229	0.0	0.0	100.0	1,753	0.0	0.0	100.0
Chemicals and rubber	445	73.0	4.5	22.5	3,927	83.4	1.8	14.8	5,813	76.3	4.0	19.8
Lumber, furniture, stone, clay and glass	231	71.9	6.1	22.0	7,214	24.6	0.7	74.7	2,512	58.8	2.1	39.0
Metals and machinery	1,971	58.2	5.0	36.8	27,400	73.2	1.5	25.3	57.688	63.7	4.8	31.5
Transportation equipment	134	89.0	0.0	11.0	3,261	43.0	0.0	57.0	7,730	6.5	0.0	93.5
Motor vehicles	41	62.4	0.0	37.6	575	76.6	0.0	23.4	557	44.9	0.0	55.1
Transportation, communication and utilities	1,685	39.1	14.2	46.7	68,458	57.8	0.7	41.5	31,030	64.9	7.4	27.6
Trade	500	70.3	7.4	22.2	34,999	89.9	2.9	7.2	5,684	69.9	10.6	19.6
Finance, insurance and real estate	259	66.1	1.8	32.0	162,985	74.2	0.1	25.7	9,913	72.4	0.7	26.9
Services	1,931	35.3	64.7	0.0	9,712	54.9	45.1	0.0	20,736	40.6	59.4	0.0
Total	7,964	52.4	22.7	25.0	350,788	68.8	2.7	28.4	154,656	58.4	13.3	28.3

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 27, 1984

TABLE 6.—APPARENT INABILITY TO CLAIM RESEARCH AND EXPERIMENTATION CREDITS IN YEAR EARNED DUE TO INADEQUATE TAX LIABILITY FOR CORPORATIONS BY GROWTH RATE CATEGORY IN 1981

Growth rate [1]	By number of returns				By total assets				By amount of tentative credit			
	Total	Percent with—			Total (millions)	Percent with—			Total (thousands)	Percent with—		
		Full use	Partial use	No use		Full use	Partial use	No use		Full use	Partial use	No use
0 base	3,936	51.6	16.3	32.1	$200,330	67.1	2.6	30.3	$38,225	61.3	10.2	28.5
0 to less than 5	88	81.6	0.04	18.4	60,763	92.1	0.0	7.9	5,197	89.0	0.0	11.0
5 to less than 10	171	63.2	9.4	27.5	57,510	63.2	1.2	35.5	9,326	71.2	3.4	25.4
10 to 20	597	70.0	3.4	26.6	378,923	65.6	4.7	29.7	102,968	59.5	7.6	32.9
20 to 40	1,132	74.9	6.4	18.6	715,907	73.9	6.5	19.5	244,990	68.7	14.9	16.4
40 to 60	960	70.3	7.1	22.6	722,002	86.1	1.2	12.7	214,803	80.8	7.8	11.4
60 to 80	724	64.0	11.0	24.9	497,057	49.4	9.2	41.5	76,662	60.0	11.3	28.7
80 to 100	621	60.4	8.1	31.4	151,845	64.1	0.3	35.5	31,917	77.3	8.2	14.5
100 to 140	1,000	57.5	34.4	8.1	242,970	83.6	0.6	15.8	33,473	74.4	11.0	14.6
140 to 200	596	63.8	15.8	20.5	58,394	46.1	3.5	50.4	28,091	40.8	8.9	50.3
More than 200	2.447	49.4	29.5	21.0	94,227	76.7	3.3	20.0	56,874	57.9	18.6	23.5
Total	12,376				3,268,194				872,081			

[1] Qualified 1981 R&E expenditures divided by base period R&E expenditures.

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 27, 1984.

TABLE 7.—CORPORATIONS WITH TENTATIVE RESEARCH AND EXPERIMENTATION CREDITS AS A PERCENTAGE OF ALL CORPORATIONS BY ASSETS EMPLOYED IN 1981

Assets employed (millions)	Corporations with credits			
	Number	Percentage of total	Assets employed	
			Amount (millions)	Percentage of total
Less than $1	4,783	0.18	$1,629	0.47
$1 to $10	4,603	2.79	15,916	3.66
$10 to $50	1,470	7.31	33,469	7.83
$50 to $100	391	10.94	27,633	11.02
$100 to $500	555	14.87	130,365	16.35
$500 to $1,000	190	28.23	134,513	28.78
$1,000 to $5,000	299	42.05	633,470	43.17
$5,000 to $10,000	53	54.08	363,369	54.62
More than $10,000	40	70.18	1,084,483	74.80
Total	12,384	0.44	2,424,847	38.45
All corporations	2,812,420	100.00	6,306,262	100.00

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 30, 1984.

TABLE 8.—GROWTH RATES OF QUALIFIED R&E EXPENDITURES, TENTATIVE CREDITS, AND PERCENTAGE OF CREDITS CLAIMED BY ASSET CLASS, 1981

[Dollar amounts in millions]

Assets employed	Qualified expenditures				1981 credits	
	Total firms	1981	Base period	1981 growth (percent)	Tentative credit	Percentage claimed
Less than $1	4,783	276.1	114.4	141.8	27.8	41.8
$1 to $10	4,601	720.5	352.2	104.5	68.0	55.2
$10 to $50	1,465	566.9	326.7	73.5	50.1	70.4
$50 to $100	391	313.4	200.9	56.0	24.7	76.4
$100 to $500	555	1,149.1	810.5	41.8	78.7	66.1
$500 to $1,000	190	903.0	640.3	41.0	62.6	64.3
$1,000 to $5,000	298	4,092.2	3,017.0	35.6	253.3	74.9
$5,000 to $10,000	53	1,528.7	1,177.3	29.9	87.4	63.4
More than $10,000	40	3,889.8	2,943.3	32.2	219.5	86.2
Total	12,376	13,440.1	9,582.7	40.3	872.1	72.2

Source: Office of the Secretary of the Treasury, Office of Tax Analysis, July 30, 1984.

TABLE 9.—RESEARCH AND EXPENDITURE CREDITS: SELECTED HIGH-TECH INDUSTRIES COMPARED TO ALL INDUSTRIES, 1981

[Dollar amounts in millions]

	High tech industries [1]	All industries
R&E credit as percentage of all:		
Percentage of firms with credit	9.45	0.44
Percentage of assets employed with credit	79.08	38.45
Percentage of receipts with credit	75.35	38.58
R&E expenditures and credits earned:		
Qualified expenditures	$5,854.3	$13,440.1
Base expenditures	$4,349.8	$9,582.7
1981 growth (percent)	34.6	40.3
Tentative credit	$356.3	$872.1
Percent of corporations with full use of R&E credit in year earned:		
(a) For corporations with qualified expenditure growth rates less than 100 percent: By number of returns	65.7	68.8

TABLE 9.—RESEARCH AND EXPENDITURE CREDITS: SELECTED HIGH-TECH INDUSTRIES COMPARED TO ALL INDUSTRIES, 1981—Continued

[Dollar amounts in millions]

	High tech industries[1]	All industries
By total assets	65.3	73.4
By tentative credit	62.8	71.5
(b) For corporations with qualified expenditure growth rates greater than 100 percent:		
By number of returns	52.3	52.4
By total assets	70.9	68.8
By tentative credit	64.0	58.4

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[1] Selected High Tech Industries:

SIC number and industry	
2815	Industrial chemicals, plastic materials, and synthetics.
2830	Drugs.
2898	Agricultural and other chemical products.
3550	Special industry machinery.
3570	Office, computing and accounting machines.
3665	Radio, television, and communication equipment.
3670	Electronic components and accessories.
3725	Aircraft, guided missiles, and parts.
3815	Scientific instruments and measuring devices; watches and clocks.
3845	Optical, medical, and ophthalmic goods.

Chairman RANGEL. Thank you, Mr. Secretary.

Information that you gathered in order to present this testimony is based on returns of 1981 or at least one-half of 1981?

Mr. PEARLMAN. It is based on all of the returns in 1981 that claimed credit which was only available for a 6-month period. The credit became effective in midyear, but it involved all returns that claimed the credit in 1981 and most, I would say, of the returns that claimed the credit in 1982.

One of our problems with 1982 data is that the process of inputting the very large corporate tax returns that are much more complex into our revenue analysis system doesn't happen as quickly and, therefore, we view that 1982 data as still preliminary.

Chairman RANGEL. So, we are dealing with one-half of 1981?

Mr. PEARLMAN. We have preliminary 1982 data and we have presented that in our statement. The most reliable data, however, is the 1981.

The implication of your statement that it is a very short period of time is true.

Chairman RANGEL. Whatever it is, I am not being critical of anything you have done, I am just wondering what we have to work with.

You are basically saying that the administration supports the credit, would like to refine and target it, and that there has been increases in expenditures. You don't know whether the increase has been related to the tax credit or just accounting procedures.

You are not really prepared to say whether or not we have benefited from this credit, but you are prepared to say that you just don't have enough information to say that it should be permanent law?

Mr. PEARLMAN. That is an accurate statement, Mr. Chairman. We know there has been an increase in the credit. We have no reason to believe that other than the normal controversies will occur between taxpayers and Internal Revenue Service in the audit process or that this information will be grossly unreliable. That is, that taxpayers are dishonest, or anything like that.

There is nothing that would suggest that. We know that there has been an increase. We suspect that the credit has had to have some incentive effect.

What we don't know is how much. You will be hearing from business and from others in the Government who can perhaps quantify what real effect the credit has had.

Chairman RANGEL. The General Accounting Office says they rely on you. You say you rely on taxpayers. It is not a question of honesty or dishonesty.

The citizens and taxpayers and Members of Congress want our businesses to be more competitive. We want to increase our exports. We want to reduce the deficit. We want to do everything that is necessary within reasonable cost in order to do this.

What has the annual revenue loss for the credit been and what is it projected to be?

Mr. PEARLMAN. I will give you a couple of numbers. The actual revenue that we show for the 1981 cost was $643 million. Our data for 1982 and 1983, which are obviously estimated, show just slightly over a billion dollars for 1982, 1.019, and for 1983, 1.363.

We estimate a slight increase in the amount of the revenue impact of the credit for 1984 and 1985. The number for 1984 is 1.460, for 1985 it is 1.552.

Chairman RANGEL. Roughly, with an extension, I would like to know what your projection of the revenue shortfall would be; also whether you are targeting and whether there will be any change in the laws.

I know we are dealing with estimates.

Mr. PEARLMAN. Let me give you a summary number. With no extension, we estimate revenue between 1981 through 1989 of just slightly under $7 billion. The credit will begin going down, there will be some savings, but I don't have that number with me.

They could be as much as half a billion dollars a year, for example. Yes, we would consider them substantial.

Chairman RANGEL. Let me say this. Assuming we have honest taxpayers, what benefits have we received in exchange for the shortfall in revenue? Basically this is what the Congress has to deal with.

Mr. PEARLMAN. If we assume taxpayers are honest, we know there has been an increase in research and experimentation expenses.

We have to presume that some of that incentive has to have come from tax incentives.

Chairman RANGEL. Why do we have to do that?

Mr. PEARLMAN. If a taxpayer gets a 25-percent tax incentive——

Chairman RANGEL. How do we know that?

People in the drug industry devote half of their business to research and development. If they don't research, they are out of business. If they don't come up with new products, they are out of business.

If the automobile industry can't compete, they are out of business. Why do we have to assume these types of credits are causing them to do what they would not normally do in their ordinary course of business?

I am not arguing with you. I want to know why you are so sure. You're recommending an extension when, quite frankly, assuming the very best, I haven't been able to find anything in your testimony to wave a flag about. We are so proud that we passed that darn thing that we can't wait to make it permanent or at least extend it until such time as Treasury can refine the definitions and close the loopholes.

Have we proven that it has been good for our economy? You know, there have been people in the administration who have already testified that they don't believe corporations should pay any taxes at all and that corporations paying taxes is really just a double tax since the stockholders are the owners.

If what you are saying is that this is another method to reduce corporate liability, I can understand that thinking to the extent that it is the administration's view. But, since we are going to have to raise some money, at least some people think so, we ought to at least cut back in spending, that is where we agree. Even though the tax credit is not truly a spending item, it is characterized as an expenditure when we write up these bills.

We have information coming in, without the availability of IRS information, that fast food companies, hair stylers, fashion designers, and a lot of people are indeed increasing their expenditures and indeed getting the credit. Based on the 6 months of information that you have, just assuming that they are spending the money, I wish you could kind of target and summarize what evidence you have that America has benefited from this R&D credit?

Mr. **Pearlman.** We included with our written statement a number of tables that try to summarize our data. Among those tables, table 9 gives some indication of the credits that were claimed by so-called high tech industries and we identify the industry categories which are generally viewed as high tech industries.

What that data will indicate is that a significant amount of the credit that is claimed is claimed by the high tech industries. We know that within the high tech industry that they do a variety of research and experimentation ranging anywhere from basic research to research and experimentation that is more directly related to immediate marketing of product.

What we don't know is how much of claimed research and experimentation expenses are in those two pockets.

Chairman **Rangel.** As a regular citizen, if you look at table 9, you'll see industrial chemicals, drugs, agricultural and other chemical product, special industry machinery, office, computing and accounting machines, radio, television, and communications equipment, electronic components and accessories, aircraft, scientific instruments, optical medical goods. Wouldn't you have some way of determining before the tax credit was in effect of deciding just how much research these people do as a part of their regular course of business?

If you go to these firms' balance sheets you are apt to see research and development as a large part of their expenditures.

My simple question is: You can see an increase in the credit for these types of industries, but you can't testify at this point about whether the increase in the credit is due to an actual increase in expenditures or due to a different method of reporting their operation.

Mr. PEARLMAN. That is right. We can't say that. What we also can't say is if the credit were permitted to expire——

Chairman RANGEL. They would go out of business if they don't compete. If we are saying that in the normal course of business a large segment of research and development is included, then I would agree with you that if the credit expires, they have to take another look at their profits, at their expenditures and some of them may not be able to compete.

But is that competition between each other? Is it foreign competition? In other words, I would like to know how does this help American industry to compete against foreign industry, not how we can write off industry's legitimate business expenses.

Mr. PEARLMAN. I think we are in complete agreement with you. We do not view the credit as a way to reduce taxes.

We view the credit as an incentive for research and development. We know that within the category of expenses that can be claimed under current law are basic research expenses.

Chairman RANGEL. Right.

Mr. PEARLMAN. Those are the expenses that without incentive, companies are most likely to drop. Those are the expenses that, in our judgment, are the ones that we should give an incentive to.

It is the unprofitable research. It is the research that is going to move the country forward technologically, but it might take some years to do that, that we want to give incentive to.

We do not know at this point what portion of claimed research and experimentation expenses are categorized as what we would view as the very basic research and those which are more closely associated with simply marketing products, but in our recommendations regarding an extension we want to make sure that an extension is targeted only to that very basic research.

Permit me to make one other comment. It is very important to not lose sight of the current incremental feature of the credit. What that does is say that if you have an increase in your R&E expenses, we are going to give you a credit based only on that increase.

Also we are going to put a cap on the amount of credit that can be claimed even if you have an absolute increase. One of the major reasons for that is to put some impediment on businesses claiming the credit being overly aggressive in claiming the credit.

So, you can have a huge increase in your credit, but because of the 50-percent limit on the amount of expenses that you can claim for the credit.

Chairman RANGEL. I know, but, Mr. Secretary, credit is a very valuable financial tool. Cutting down a gift is not oppressive.

Is it fair to say that the administration believes that there are benefits that accrue in terms of research and development with this credit, but because of very limited data, at this point, they can't really testify to any real benefits achieved, or any true research that has been done, because this is a long going process and industry has to be able to depend on, with some degree of certainty, that even though you don't have any positive evidence of its actual value, that you need another 3 years in order to take a look at it to see really whether any real value has come rather than any assumed value based on the increase in the expenditures?

Mr. **Pearlman**. The only qualification I would make to that statement is that we do know from the tax return data that there in fact have been significant increases in research and experimentation expenses.

What we don't know is to what extent has the credit been the incentive for that.

Chairman **Rangel**. Now, we hope that you will be able to go back to the drawing board, go beyond the Senate recommendations and be able to put on the IRS tax form questions that a layman will be able to use to determine whether this research credit is being used, the type of research involved, what it has been used for, what have been the benefits of it. Something that we can really get a handle on.

Have you been able to determine even in the 1981 cases whether there have been uses of this credit that the administration didn't intend?

Mr. **Pearlman**. That will be data that will be available, but that data is going to simply have to await the examination process. But in the examination processes revenue agents are going to be looking at what did the taxpayer claim the credit for.

Chairman **Rangel**. You haven't had a chance to hear the horror stories of hair stylists using this credit?

Mr. **Pearlman**. We have seen in the press the same kind of reports you have.

Chairman **Rangel**. Is McDonalds using it or people like McDonald?

Mr. **Pearlman**. Mr. Chairman, I will be happy to go back to see if I can provide that information to you.

Chairman **Rangel**. There has been no information that has come across your desk that causes you any alarm to say this has to stop?

Mr. **Pearlman**. I have had no information come across my desk with respect to the specifics of the use of the credit.

Chairman **Rangel**. What question should I ask these people who have been receiving the credit?

The General Accounting Office says they don't know whether any benefits are received because they don't have access to the tax returns. You really know it is a good idea, but it is too early to see how good it is, but it is going to cost a lot of money.

You think you will be able to get some better information down the line. You said that the beneficiaries would be able to better tell me how the country is benefited rather than just the firms and stockholders.

What questions should I ask them?

Mr. **Pearlman**. We have been interested and I presume, Mr. Chairman, you will be interested in listening to businesses explain their research and development programs and what role the credit has.

Chairman **Rangel**. Do you expect the witnesses will say that it is unnecessary?

Mr. PEARLMAN. I don't know whether they would or not, but I would be interested in that. I will be interested in reading the transcript to see if they do.

Chairman RANGEL. Will you be putting together the projected budget for 1985 and deciding where we are going to have to cut back in spending and where we have to raise money?

Mr. PEARLMAN. Our office undoubtedly will be asked. We do the revenue estimates for the budget, receipt estimates for the budget, and in connection with the budget process should we be asked questions regarding changes in the tax system, we would be involved.

Chairman RANGEL. Have you put together a list of where we should be looking in terms of raising revenue within the tax system?

Mr. PEARLMAN. We have not done any work in connection with the next budget. We have not done anything on that at this point.

Chairman RANGEL. As a professional, you would know that credits would be included in that study?

Mr. PEARLMAN. We would not assume at this point that we would do anything in terms of revenue adjustments for fiscal 1986 at this point.

All we do in terms of the budget is estimate receipts under current law. That would be our responsibility at this point.

Chairman RANGEL. Actually you don't get too much involved in policy as it relates to what is important to the administration, what has to be protected and how strongly they feel about certain issues? Would that not be within your office?

Tuition tax credits, you would not just say that is very important to us because the country is dependent on the credit to improve education?

Mr. PEARLMAN. What we try to do, Mr. Chairman, when matters involving the tax system are raised on a policy basis is to provide the best legal, technical, economic judgment we can so that the President and his advisers can make the policy decisions that need to be made.

Chairman RANGEL. Have you made one on tuition tax credit yet?

Mr. PEARLMAN. The tuition tax credit is in the fiscal 1985 budget. As I indicated to you, I have not heard one single word about the fiscal 1986 budget. That process does not start until very late in the year, typically in December.

Chairman RANGEL. Does that come specifically to your office in terms of expenditures and what it is going to cost?

Mr. PEARLMAN. We will make the revenue estimate with respect to any tax incentive that is contained——

Chairman RANGEL. Has it been done for tuition tax credit yet?

Mr. PEARLMAN. The fiscal 1985 budget——

Chairman RANGEL. You don't know that figure?

Mr. PEARLMAN. Not off the top of the head.

Chairman RANGEL. What about the tax-free enterprise zones. Do you know how much that cost?

Mr. PEARLMAN. That information is available. I can provide it to you.

Chairman RANGEL. How about the Social Security COLA?

Mr. PEARLMAN. Again, sir, I don't have the numbers.

Chairman RANGEL. Maybe you might want to provide all of the measures that are involved in the tax system that the administration is proposing and submit that to the committee as it relates to cost because unfortunately we have to report back to the voters and we just can't do what we are told.

We have to see which items receive the most priority and before this year is out, we suspect that a lot of priorities will be coming from the administration and we would like to take advantage of your expertise on how costly they are in terms of budget and then, of course, we would like to evaluate the benefit that American taxpayers are receiving from them.

I apologize for asking you all of these questions, but you realize you are all I have this morning.

Mr. PEARLMAN. No apology necessary. I will be happy to provide that data.

[The following was subsequently received:]

COMMITTEE ON WAYS AND MEANS,
SUBCOMMITTEE ON OVERSIGHT,
Washington, DC, August 20, 1984.

Mr. RONALD A. PEARLMAN,
Acting Assistant Secretary for Tax Policy, U.S. Department of the Treasury, Washington, DC.

DEAR MR. PEARLMAN: Thank you for your recent testimony before the Subcommittee on Oversight concerning the twenty-five percent incremental research credit. Your testimony and written statement will be most useful to the Committee in its future analysis of the issues surrounding the credit.

To insure that the Subcommittee's hearing record is as complete as possible, there are several remaining issues which need to be addressed by the Department of Treasury. I have attached a list of follow-up questions for your response. I would like to receive your comments, and thus close the hearing record, by September 28, 1984. If you have any questions, please feel free to contact Beth Kuntz, Assistant Counsel, Subcommittee on Oversight, at 225-5522.

Sincerely yours,

CHARLES B. RANGEL,
Chairman.

Enclosure.

QUESTIONS FOR THE DEPARTMENT OF THE TREASURY

1. If the Congress extended the R&D tax credit in its current form, what would the annual revenue loss be?

2. If the Congress had adopted the changes to the R&D credit as provided for in the Senate's version of the Deficit Reduction Tax Act of 1984, what would the annual revenue loss be?

3. Professor Edwin Mansfield, Professor of Economics, University of Pennsylvania, recently completed a study (under contract by the National Science Foundation) on the impact of the R&D tax credit. In surveying 110 firms which accounted for 30 percent of all company-financed R&D, Professor Mansfield reports that:

(a) Without the tax credit, the R&D expenditures of the 110 firms in the sample would have been about 0.4 percent lower in 1981, about 1.0 percent lower in 1982, and about 1.2 percent lower in 1983, according to the firms themselves.

(b) Further, based on the firms' estimates, the extra R&D stimulated by the tax credit seems to have been considerably less than the revenue loss to the Treasury. For 1981, it is very unlikely that the tax-credit-induced R&D exceeded $208 million. The revenue loss was $600 million according to the Treasury. For 1982, it is very unlikely that the tax-credit-induced R&D exceeded $638 million. The revenue loss was estimated to be about $1 billion.

Please comment. Does Treasury agree?

4. Some researchers have asserted that the R&D tax credit provides firms with an incentive to redefine activities as research. For example, Professor Mansfield's study (and others) indicates that reported R&D expenditures of firms surveyed increased by 4 percent per year in 1982-3 for this reason alone. To what extent does Treasury

believe the amount R&D expenditures reported to the IRS have increased because of the redefinition of activities as R&D? How does the amount of research expenditures claimed for purposes of the credit compare to the amount of research expenditures reported to the Securities Exchange Commission (SEC)?

5. One of the main reasons the Congress and Treasury have had problems in evaluating the effectiveness and use of the R&D credit is the lack of definitive information on exactly what types of activities the R&D credit is subsidizing. The IRS does not collect much substantive information from taxpayers claiming the credit. Form 6765 basically only requires the taxpayer to categorize their R&D expenditures by wages, supplies, and lease costs.

(a) Would the Treasury support a requirement that firms claiming the credit provide the IRS with the following basic information? The specific type of R&D activity involved (using a code list developed by the IRS); the product to ultimately be produced or improved; whether the R&D relates to improvement of an existing product or development of new product; whether the product involved will be manufactured or used by the researcher;

(b) What other information is needed to evaluate the credit in the future?

6. If the Committee chose to draft the narrowest possible definition of eligible R&D expenditures, what types of activities should be included? Basic research; experimental activities; high tech activities; small business; other?

7. Under present law, a taxpayer can claim the R&D tax credit and a tax deduction (under the Section 174 election to expense certain R&D costs) for many of the same expenditures.

(a) What is the rationale (justification) for allowing such double deductions?

(b) Does Treasury support or oppose the present law rules which allow this to occur?

8. (a) Two economists suggested that the R&D tax credit should not be computed on a 3-year incremental basis (as provided for under present law), but rather should be based on a percentage of the firm's total R&D expenditures in a given year or based on an industry basis. Please comment.

(b) In addition, several economists argue that in order to balance the benefits of the R&D tax credits between high technology firms and those in older industries, the R&D tax credit should be refundable. (Present law rules provide for a 3-year carryback and a 15-year carryforward).

(1) Please comment.

(2) What percentage of the firms having incremental R&D were able to use the credit? What percentage carried the credits forward?

9. In the past, industry groups have urgued the Congress to consider a proposal that they claim is "revenue neutral". It involves extending the depreciation period (ACRS) for R&D equipment from 3 to 5 years and making changes to the eligibility rules for the credit.

(a) Please describe and comment on the various such proposals industry has submitted to Treasury.

(b) How would the investment tax credit (6 percent for 3-year property and 10 percent for 5-year property) be treated?

(c) Would such options be revenue neutral? In the short term? In the long term?

10. What types of activities (or expenses) have taxpayers been particularly aggressive in characterizing as R&D? (i.e., which issues are typically the subject of audit?)

11. Why haven't final regulations for the R&D credit been promulgated? Doesn't this allow usually wide latitude in calculation of the credit, particularly in the category of "qualified" R&D expenditures?

12. Proposed Treasury Regulations and Proposed Amendments describe the eligibility of computer software expenditures for the R&D credit.

(a) How has the Treasury defined eligible software-related expenditures under the Regulation?

(b) Why has the Regulation been so controversial?

(c) What types of case examples has the IRS identified that cause Treasury concern?

(d) If the credit is restructured, how should eligibility of expenditures for software research be treated?

13. Under present law rules, qualified research expenses do not include land or depreciable property, but do include certain lease payments. As a result, for many taxpayers, it will be advantageous for them to lease rather than purchase property to be used in research.

(a) Should the credit be structured to encourage the lease rather than the purchase of R&D equipment?

(b) Are any changes or limits in order?

(c) Can a special case be made for computer time charges?

14. The Senate version of the Tax Reform Act of 1984 contained provisions which would have extended the R&D tax credit and made a significant number of substantive modifications to present law rules. During hearings before the Senate and during the House-Senate Conference of the tax bill, the Treasury indicated its support for the Senate provisions.

(a) Briefly describe the changes to present law rules that Treasury supports and considers necessary.

(b) In what specific ways could the Senate legislation be improved even further.

15. The President's Commission on Industrial Competitiveness (PCIC), in a hearing sponsored by the American Enterprise Institute on June 12, 1982, was urged by numerous economists to "garner support" for a simplier and more long-term research and development tax credits that could remove disincentives for R&D projects by high technology firms.

(a) Has PCIC taken a position or made specific recommendations regarding how the R&D tax credit should be changed?

(b) What has the PCIC learned thus far concerning the effectiveness and continued need for the R&D tax credit?

(c) What is the status and timetable for the PCIC's work?

16. Also, it has been reported that the Administration's Cabinet Council on Economic Affairs is expected to take a position on the R&D tax credit and suggest changes that would improve its effectiveness. Have recommendations been made?

17. To what extent has the R&D tax credit been used in tax shelter schemes?

18. Numerous reports (including a Wall Street Journal article dated September 26, 1983) indicate that R&D tax shelters are proliferating, in part, because R&D shelters offer investors write offs of 80-90 percent of the investment plus "a shot at high profits".

(a) To what extent does Code section 174 (allowing the expensing of R&D costs) allow limited partners to write-off such a large percentage of their investment?

(b) To what extent can R&D partnership profits be distributed to investors as long-term capital gains?

COMMITTEE ON WAYS AND MEANS,
SUBCOMMITTEE ON OVERSIGHT,
Washington, DC, December 19, 1984.

Mr. RONALD A. PEARLMAN,
Assistant Secretary for Tax Policy,
Department of Treasury,
Washington, DC.

DEAR MR. PEARLMAN: On August 2 and 3, 1984, the Subcommittee on Oversight held hearings on the impact of the research and experimentation tax credit. As a result of your testimony on behalf of the Administration, I submitted a series of questions to your office for response. A copy of my August 20, 1984 letter is attached for your review.

The Subcommittee staff is in the process of analyzing the information submitted at the hearing and preparing a report on our findings. In addition, the full Committee has requested that our hearing record be submitted to them, in final form, for printing before the end of the session. It is imperative, therefore, that I receive a complete response to the Subcommittee's inquiries before January 18, 1985. While I understand that staff has informally agreed to delays in Treasury's response from the original requested due date of September 28, 1984, it will not be possible to delay completion of the Subcommittee's hearing record any further.

I appreciate your attention to this matter.

Sincerely yours,

CHARLES B. RANGEL,
Chairman.

Enclosure.

DEPARTMENT OF THE TREASURY,
Washington, DC, February 6, 1985.

Hon. CHARLES B. RANGEL,
Chairman, Subcommittee on Oversight,
House of Representatives,
Washington, DC.

DEAR MR. CHAIRMAN: We have enclosed the Treasury Department's responses to the questions which you submitted on the research credit. I apologize for the delay in responding.

If we can provide additional information or assistance, please contact me.

Sincerely,

RONALD A. PEARLMAN,
Acting Assistant Secretary
(Tax Policy).

Enclosures.

TREASURY DEPARTMENT RESPONSES

1. The Treasury Department estimates that the annual revenue loss for the credit is approximately $1.5 billion.

2. The Treasury Department estimates the changes to the definition would reduce the annual revenue loss for the credit by approximately $75 million.

3. Professor Mansfield's survey does provide useful data, but it is not definitive proof that the credit is not an effective incentive. The Treasury Department generally does not regard taxpayer responses to surveys on the incentive effect of the credit sufficiently reliable to make decisions as to the future of the credit.

In addition, in evaluating the results of Professor Mansfield's survey, it is important to bear in mind that additional benefits inure to society from increased research expenditures. Therefore, the revenue loss associated with the credit cannot be judged merely against the dollar amount of increased research expenditures.

4. Treasury is concerned that reported R&E expenditures may have increased because of reclassification of expenses as research expenditures. From the data available to us, we cannot determine to what extent taxpayers reclassified expenses.

In this regard, the Treasury Department has not attempted to compare he level of expenses reported on tax returns with expenditures reported to the SEC.

5. The Treasury Department would support a reasonable requirements that taxpayer provided additional information on the types of activities for which the R&E credit is claimed. Information as to the result sought and the procedures planned to achieve the intended result would aid the Internal Revenue Service in determining whether, at the time the taxpayer commenced a research project, the activity qualified for the credit. The specific information required should depend on the formulation of a new definition of qualifying research.

6. In general, the activities that should be included in a narrow definition of eligible R&E expenditures are those that provide the greatest public benefit, but promise the least immediate expectation of profit. These activities include basic research and experimental activities designed to further technological advancement.

The definition contained in the Senate version of the Tax Reform Act of 1984 (the "Senate definition") represents an attempt to limit the availability of the credit to basic research and innovative private development activities. These activities are most likely to produce benefits to society in addition to the return captured by the private firm.

7. The primary economic justification for allowing a tax deduction for R&E expenditures and an R&E credit is the benefit provided to the nation as a whole from technical advances. Treasury supports a limited extension of present law with adjustments to tighten the definition of qualified R&E.

8. (a) The incremental aspect of the credit may result in different incentives among taxpayers to increase research expenditures. Removing the incremental feature of the credit would eliminate the incentive for firms to increase R&E and provide windfall benefits to other firms and would have performed R&E in the absence of incentives.

(b) All incentives to be fully neutral should be refundable. However, revenue considerations typically dictate establishing non-refundable credits.

The percentage of R&E credits used against current year tax liability was presented in Treasury testimony. The R&D credit amounts carried back against tax liability in the three prior years is difficult to establish.

9. Three- and five-year equipment obtain about the same long run present value of total tax benefits from depreciation deductions and investment credits. Therefore, classifying research equipment as five-year property would essentially be revenue neutral in the long term, although short-term revenue increases could result from differences in the timing of deductions.

10. We are not aware of particular classes of activities for which taxpayers have inappropriately claimed the credit. Internal Revenue Service audits have, however, dealt with particular instances in which taxpayers may have improperly claimed the credit. This audit experience has not uncovered any general patterns of abuse which would indicate that particular exclusions from the definition of qualifying research are appropriate.

11. The Internal Revenue Service issued proposed regulations under Section 44F and 174 on January 21, 1983. The proposed regulations generated a significant number of comments and the Service has reevaluated the proposed regulations in light of these comments. At this time, however, we cannot state definitely when final regulations will be published.

12. Under the proposed regulations, expenses incurred to develop computer software generally do not qualify for the credit. The proposed regulations provide that software development costs qualify for the credit only if the software is new or significantly improved. Under this standard, costs of developing software qualify for the credit if the process of developing software involves a "significant risk that it cannot be written." The examples in the proposed regulations illustrate some situations which created concern over the availability of the credit for software development costs. Many of the comments which the Internal Revenue Service received on the proposed regulations argued that the legislative history of Section 44F did not support the general approach of the proposed regulations.

If the R&E credit is extended and the definition of qualifying research revised, the credit should be available for innovative software applications. A higher standard, however, is appropriate for costs incurred to develop software for use in the taxpayer's trade or business. For the credit to be available for the costs of developing internal use software, a taxpayer should demonstrate that the software being developed will achieve a significant increase in speed or decrease in costs, that a significant risk exists that the software cannot be developed and that the software which would satisfy the taxpayer's objective is not commercially available.

13. The Treasury Department believes the R&E credit should not encourage taxpayers to lease, rather than purchase, equipment used in research. Therefore, the Treasury Department supports eliminating the disparity between leased and purchased equipment by limiting the availability of the R&E credit to costs incurred for supplies and wages.

14. The definition of qualifying research in the Senate version of the Tax Reform Act of 1984 (the "Senate definition") attempts to target private research activities designed to lead to technological innovation in products and processes. At the same time, however, the Senate definition is intended to permit taxpayers to know with reasonable certainty what research activities qualify for the credit.

The Treasury Department considers critical both the focus of the Senate definition on new or technologically improved products and processes and the requirement that research relate to a process of experimentation. Further refinements in the Senate definition, such as identifying additional exclusions from the scope of qualifying research, may be appropriate to ensure that the credit does not subsidize private research activities which are not innovative.

15. The Treasury Department suggests that the views of the President's Commission on Industrial Competitiveness [PCIC] be obtained from the PCIC directly.

16. To date, the Cabinet Council on Economic Affairs has not made any additional recommendations for the improvement of the credit.

17. The Treasury Department is not aware of widespread use of the R&F credit in tax shelters.

18. Section 174 allows a taxpayer to deduct currently R&E expenses incurred in connection with taxpayer's trade or business. The expensing election permitted by Section 174 is an exception to the general rule that a taxpayer must capitalize costs incurred to develop an asset which has a useful life that extends beyond the taxable year.

Large write-offs for investors in many R&E limited partnerships are a consequence of leveraged payments of qualifying research expenses. Although such write-offs are not a direct consequence of the ability to deduct currently qualifying expenses, Section 274 does not limit deductions to amounts which investors have "at risk."

Under Section 1235, a partnership may transfer "property consisting of all substantial rights" to a patent and the individual investors may treat payments received as long-term capital gain. *See* Treas. Reg. § 1.1235-2(d)(2). If Section 1235 is not available, a sale of technology developed by a limited partnership may still qualify as the sale of a capital asset, but, in particular circumstances, the status of a process or invention as a capital asset under the relevant provisions of the Code may be in doubt.

Chairman RANGEL. Thank you, sir.

The Congressional Budget Office, Dr. Rudolph Penner, the Director.

Doctor, we have your full statement for the record. Of course, what we are trying to find out is whether or not the extension of the research and development tax credit as adopted in the Economic Recovery Tax Act makes any sense and how it has been used, misused, or abused.

You have seen the difficulty I have had in trying to find some answers to what the benefits are. We know the cost. As long as the cost is out there, there will be an increase in the use of credit.

Your office has been very helpful, in a nonpartisan way to the Congress, in trying to get some answers to the questions that we are raising. Not only do we appreciate the fact that you have provided us with your statement and your testimony, but we do hope that as the record remains open and before we reach a legislative decision, that your office will feel free, without invitation, to come forward with any additional information that might assist us in reaching a legislative conclusion.

STATEMENT OF HON. RUDOLPH G. PENNER, DIRECTOR, CONGRESSIONAL BUDGET OFFICE

Mr. Penner. Thank you very much, sir.

We will certainly try to do that.

Chairman Rangel. You may proceed.

Your entire statement will be entered into the record without objection.

Mr. Penner. I would like to summarize it very briefly, sir.

I am pleased to participate in these hearings on the research and development [R&D] tax credit.

In my testimony today I shall consider the role of the R&D tax credit; in Federal and private research in the United States and focus on specific questions about the credit; namely, how has it affected the private research effort? Should it be renewed either permanently or temporarily? And if renewed, in what form?

My complete testimony also shows how it fits into the overall pattern of Federal support for research and innovation.

The design of the R&D tax credit makes it less effective than it would seem at first. A firm with R&D expenditures that are higher than its base in any year receives a credit. At the same time, this raises its base in future years and, therefore, lowers the firms opportunities to qualify for future credits.

Thus, an extra dollar of R&D investment receives the 25-percent credit, but it also raises the base by 33 cents in each of the ensuing 3 years. This feedback effect reduces the opportunity to earn credits in each of those coming years by 8.3 cents—25 percent times 33 cents.

For a firm in this situation, the R&D credit does not lower taxes; rather, it postpones them, providing interest on the value of the credit in the interim—or, "the time value of money."

The incentive provided by the credit can vary greatly from firm to firm. To one that steadily increases its R&D spending above its qualifying 3-year average, the credit's value will be much reduced. At a nominal 15-percent discount rate, the credit would be worth 6 percent to the firm, or less than one-fourth the statutory level.

The full credit will be available only to a firm that increases research expenditures in 1 year and then returns to its base R&D spending level.

In other circumstances, the credit can actually be negative. For instance, if a firm's R&D spending is well below its qualifying base for the current year, incremental R&D expenditures would only serve to increase the firm's future tax liabilities.

In this instance, the incremental expenditures would not qualify for the credit, but they would be counted in the firm's base for future credits. Of all firms in 1981, 15 percent fit into this category.

The credit is, of course, irrelevant for a firm expecting no tax liability.

The R&D tax credit can only be effective if it reduces the after-tax cost of doing research. Obviously, tax provisions are not the only variables that can influence research costs. The state of the economy also plays a role, as do an individual firm's prospects and its available technological choices.

In addition to reducing costs, the R&D credit can also improve the cash flow of firms that pursue research. R&D costs can be gauged by the user cost of capital. This will be determined by the expected economic life of the research results, prevailing interest and inflation rates, and the tax treatment of various assets and of debt.

The assumptions underlying our analysis are fully described in the complete text.

The credit can also be assessed in terms of its effect on tax liabilities resulting from investment in R&D. As shown in table 1, the credit turns tax rates negative—that is, it makes the after-tax rate of return greater than the before-tax rate of return—for most R&D projects, although its absolute value is small.

Without the credit, the before- and after-tax rates of return would be roughly the same, since the bulk of R&D costs would be deducted from profits as they were incurred. In other words, the credit subsidizes R&D investments for most firms. But the credit's subsidy value varies with economic life. Long-term investments receive less subsidy than short-term investments—not a very desirable result. Finally, although some of the tax rates are positive, all of them still fall below the marginal corporate tax rate. The credit, however, reduces the cost of doing research by less than tax-rate estimates suggest. Table 2 displays the effects of the credit on the after-tax cost of doing research under the same assumptions used for the results reported in table 1. For a typical 10-year project in a firm that plans steadily increasing R&D expenditures (see table 2, case 1), the tax credit lowers the cost of capital from 18.8 to 17.4 percent. The contrast, the full 25 percent value of the credit would have further lowered the research cost to 13 percent. But for a firm that is not eligible, such as a new firm in an industry, the credit provides disincentives by raising the cost of R&D from 18.8 to 23.2 percent.

Though total industry R&D has grown both in nominal and constant dollar terms since the credit was passed, it has grown at a decreasing rate. Since 1978, industry R&D has risen at an annual rate of 14 percent in nominal terms. After the credit was passed, however, the annual growth rate has slowed to 11 percent.

The recession, which depressed company profits, might have reduced R&D growth rates even further had there been no credit. But it is not possible to make a definitive assessment of the credit's effect on R&D activity during that time.

With the R&D tax credit's expiration date approaching, the Congress must now decide whether to let it lapse or to extend it, and if the latter, whether to do so in its present form or a modified one.

If the Congress were to allow the credit to expire, expensing would still provide a considerable tax advantage for R&D, but the relative advantage would be less than before 1981 and 1982 tax legislation, which greatly reduced tax burdens on other investments.

There are several arguments for expiration. First, the prospect of a large budget deficit suggests extreme caution about any revenue-losing measure, especially one of unknown effectiveness. Second, since most industrial research is for product development, not for basic or applied research, the usual economic arguments for favorable tax treatment are not entirely appropriate.

The main argument for renewal in some form is that technological change is a major contributor to economic growth, and without some encouragement for R&D, the marketplace will not devote enough resources to innovation.

If the Congress wished to change and extend the credit, it could consider three possible changes:

It could refocus the credit toward more basic and applied research.

It could eliminate some of the disincentives now inherent in the current structure.

It could expand the benefits of the credit into new areas.

And if the Congress wanted to take a different approach, instead of trying to subsidize R&D with the tax system, it could try to subsidize it with direct grants on the spending side of the budget.

For time's sake, I am not going to go into our complete analysis of all these options, but obviously I shall be pleased to answer any questions you have.

I think it is worth spending a moment, however, on whether any extension should be temporary or permanent.

The administration has proposed extending the incremental R&D tax credit for another 3 years. It argues that experience with the credit has been very short and because of the intricacies involved in such definitions of "qualified research," another congressional examination is warranted 3 years after renewal.

On the other hand, permanent extension would facilitate firms developing long-term financial plans. As a result, current and future research might rise more than it would under a temporary extension.

Thus far, Mr. Chairman, I have looked at the R&D tax credit in isolation. I have not really looked at how it interacts with the rest of the Tax Code.

In general, the more the tax system is burdened with credits and special exemptions, the less effective each credit or incentive becomes. This is certainly so when companies have so many credits and deductions available to them that they can completely cancel out their current and future tax liabilities.

At that point, tax incentives are no longer effective. In 1981, half of all corporations had no tax liabilities. We have reached the point where our tax system is asked to do so much that it does nothing very well. That includes its fundamental purpose—raising revenues.

The economic incentive of each new credit, or special deduction, is also reduced as other economic activities are offered preferred tax treatment. For example, the availability of the investment tax credit tends to dilute the effect of the R&D credit by making investment in capital equipment comparatively more attractive than if no credit were allowed. As more economic activities are given such special treatment, each activity loses its comparative advantage, thereby negating the effects of any one incentive.

Furthermore, the proliferation of tax credits, as well as uncertainty about their status, makes the Tax Code more cumbersome, complicates the investment planning of firms, and can raise the public's perception that the tax system is unfair.

Thank you, Mr. Chairman.
[The prepared statement follows:]

STATEMENT OF RUDOLPH G. PENNER, DIRECTOR, CONGRESSIONAL BUDGET OFFICE

Mr. Chairman, I am pleased to participate in these hearings on the extension of the Research and Development (R&D) Tax Credit (Internal Revenue Code Section 44F). In my testimony today, I will consider the role of the R&D tax credit in federal and private research efforts in the United States and focus on several specific questions about the credit:

How does it fit into the overall pattern of federal support of research and innovation?

How has it influenced private research efforts?

Should it be renewed, either permanently or temporarily, and if renewed, in what form?

FEDERAL SUPPORT FOR R&D

The federal role in funding both military and civilian R&D has been sizable for four decades. Unitl the late 1970s, the federal government spent more money on R&D than did the entire private sector. Federal R&D spending accounted for $40 billion of the $88 billion spent nationwide on R&D in 1983. Private industry accounted for $44 billion and not-for-profit research institutions, including universities, accounted for the rest.

The aim of Federal support for R&D

The rationale for federal support for civilian R&D is that imperfections in private markets may dissuade companies from investing adequate sums of money in socially valuable products and processes. Specifically, government aid is conceived to overcome the disincentive of a firm's developing a valuable product or process, then losing part of the resulting benefits to imitators, who can apply this innovation to their own ends without undertaking the cost of producing it. Thus, federal R&D policies—a mix of direct spending, tax benefits, and patent laws—are designed to overcome what economists term the "nonappropriability" of private R&D efforts. At present, the main thrust of current federal efforts in support of civilian innovation is to provide a supportive framework and some incentives. But the central technological decisions remain private. (This is a significant change from the 1970s, when the federal commercialization effort was large—especially in the area of energy research.)

The distinctions between basic research, applied research, and development are essential to any discussion of federal R&D policy, tax related or other. In simple terms, basic research is an inquiry into the causes and effects of physical phenomena, done for its own sake; the potential practical and marketable applications of its results are strictly incidental. Applied research, in contrast, is undertaken to solve practical problems, rather than to expand the frontiers of knowledge; it is not directed toward a specific product or process. Development—accounting for more than two-thirds of private R&D spending—is undertaken to solve the technical problems involved in bringing new products or processes to market. Firms spend between one-fifth and one-quarter of their funds in applied research; they spend only a small portion of their research funds on basic research.

The recent record of direct Federal spending for R&D.—Direct federal spending on civilian R&D recently has declined both in constant-dollar terms and as a percent of total federal R&D efforts. In fiscal year 1980, direct federal spending for civilian R&D totaled $19.5 billion (in 1982 dollars), or 52.7 percent of all federal R&D spending. By fiscal year 1984, civilian R&D had decreased to $15.2 billion (in 1982 dollars), or 34.2 percent of the total. The main losers have been development programs. Support for civilian basic research has grown in constant-dollar terms, while funding of applied research has declined slightly. The R&D tax credit belongs in this category, in that it supports civilian science and technology.

The tax treatment of R&D

To complement direct support, the Congress has traditionally given R&D efforts favorable tax treatment. Before 1981, while the tax code allowed other business investments to be depreciated over time, it permitted many corporate investments in R&D to be deducted from taxable income in the year they were incurred. But tax changes made in 1981 and 1982 have permitted most short-term investments to receive the present value equivalent of expensing because of the investment tax credit (ITC) and the accelerated cost recovery system (ACRS).

The R&D tax credit.—To maintain R&D's preferential tax treatment, the Congress passed the "incremental" R&D tax credit as part of the Economic Recovery Tax Act of 1981 (ERTA). The provision grants a credit equal to 25 percent of the increment of "qualified" R&D expenditures (primarily direct wage and material costs) any firm makes over and above its average R&D spending for the three years prior to claiming the credit. In covering primarily the direct wage and material costs associated with R&D, the credit takes account of only two-thirds of total research costs.

In the first year of the credit's implementation, a revenue loss of more than $600 million resulted. The Joint Committee on Taxation (JCT) projects a loss of $1.5 billion in 1985. According to the JCT, even if the credit expires on schedule, it will incur tax losses after 1985 because ERTA allows unused credits to be carried forward to future tax years. If the credit is renewed without change, losses attributable to it could continue at the 1985 level or higher.

The R&D tax credit is most likely to support the development component of R&D. Of the $44 billion private industry spent for R&D in 1983, almost three-fourths, or $32 billion, went for development.

HOW HAS THE CREDIT INFLUENCED PRIVATE INDUSTRIAL R&D

The design of the R&D tax credit makes it less effective than it would seem at first. A firm with R&D expenditures higher than its base in any year receives a credit, but at the same time raises its base in future years and therefore, lowers its opportunities to qualify for future credits. Thus, an extra dollar of R&D investment receives the 25 percent credit, but it also raises the base by 33 cents in each of the ensuing three years. This "feedback" effect reduces by 8.3 cents (25 percent times 33 cents) the opportunity to earn credits in each of those coming years. Thus, for a firm in this situation, the R&D credit does not lower taxes; rather, it postpones them, providing interest on the value of the credit in the interim (or, "the time value of money").

The incentive provided by the credit can vary greatly from firm to firm. To one that steadily increases its R&D spending above its qualifying three-year average, the credit's value will be much reduced: at a nominal 15 percent discount rate, the credit would be worth 6 percent to the firm, or less than one-fourth the statutory level. The full credit will be available only to a firm that increases research expenditures in one year and then returns to its base R&D spending level. In other circumstances, the credit can actually be negative. If, for instance, a firm's R&D spending is well below its qualifying base for the current year, incremental R&D expenditures would only serve to increase the firm's future tax liabilities. In this instance, the incremental expenditures would not qualify for the credit, but they would be counted in the firm's base for future credits. Of all firms in 1981, 15 percent fit into this category. (The credit is, of course, irrelevant for a firm expecting no tax liability.)

Thus, the credit is haphazard in its effects, and its value often depends on a firm's past actions and tax status. Moreover, much uncertainty surrounds the value of the credit to individual firms because of their inability to forecast accurately future output, income, and tax liabilities.

The credit's effects on the costs of doing research

The R&D tax credit can only be effective if it reduces the after-tax cost of doing research. Obviously, tax provisions are not the only variables that can influence research costs. The state of the economy also plays a role, as do an individual firm's prospects and its available technological choices. Besides reducing costs, the R&D credit can also improve the cash flow of firms that pursue research.

R&D costs can be gauged by the "user cost of capital." This will be determined by the expected economic life of the research results, prevailing interest and inflation rates, and the tax treatment of various assets and of debt.

The cost of pursuing R&D must be measured over the economic life of research results—that is, the length of time a project's results yield economic benefits to the originating firm. Because of the difficulties in estimating a research project's economic life, the Congressional Budget Office has chosen to analyze possible lifespans of 5, 10, 15, and 20 years. CBO's estimates assume a nominal discount rate equal to a before-tax interest rate of 15 percent and an inflation rate of 4 percent. A higher interest rate would increase the present value of the credit, but it would also increase the cost of capital. (The text box on page 8 summarizes CBO's analytic cases and assumptions.)

CBO'S ANALYTIC CASES AND ASSUMPTIONS

To analyze the effects of the R&D tax credit in its present or possibly modified form, CBO examined three typical cases. In analyzing all three cases, CBO assumed an annual interest rate of 15 percent and an annual inflation rate of 4 percent. The cases otherwise differed in the following respects.

In the base case, Case 1, the firms were considered to be profitable, with R&D expenditures increasing steadily in nominal terms. All firms were assumed to take full advantage of all tax benefits available and for which they qualified, including the R&D tax credits.

In Case 2, CBO assumed that firms were ineligible for the credit in the first year, but would become eligible in subsequent years. Otherwise, assumptions resembled those underlying Case 1. Case 2 would be relevant for firms with R&D spending below average for one year and then increasing spending above average levels, and for existing firms undertaking new R&D efforts to enter a new market. New entrants are ineligible for the credit. In either case, firms increasing R&D spending would receive no credit, but would face a higher base average in future years.

In Case 3, firms do not have tax liabilities sufficient to qualify for the credit. They do, however, fully exploit other available tax advantages such as the investment tax credit and expending of wages and material costs.

The credit can also be assessed in terms of its effect on tax liabilities resulting from investment in R&D. As shown in Table 1, the credit turns tax rates negative—that is, makes the after-tax rate of return greater than the before-tax rate of return—for most R&D projects, although its absolute value is small. Without the credit, the before-tax and after-tax rates of return would be roughly the same, since the bulk of R&D costs would be deducted from profits as they were incurred. In other words, the credit subsidizes R&D investments for most firms. The credit's subsidy value varies with economic life, and long-term investments receive less subsidy than short-term investments—not a very desirable result. Finally, although some of the tax rates are positive, they all still fall below the marginal corporate tax rate.

TABLE 1.—EFFECTIVE TAX RATES OF INDUSTRIAL R&D RESULTING FROM R&D TAX TREATMENT—3 CASE STUDIES

.[In percent per year]

Tax policy	Economic life of R&D investment			
	5 yr	10 yr	15 yr	20 yr
Case 1 (base case):				
No credit	1.2	1.1	1.1	1.1
Current credit	−29.8	−17.2	−13.5	−11.7
Full credit	[1] NA	−184.6	−113.6	−89.9
2-yr lag in base period	−71.6	−36.8	−28.1	−24.2
Including equipment depreciation	−30.6	−17.6	−13.8	−12.0
Expensing R&D capital costs	−27.4	−16.5	−13.2	−11.7
Case 2: Current credit on a current-year base	43.8	33.9	29.8	27.5
Case 3:				
Current credit on a current-year base	−10.9	−6.4	−5.0	−4.4
Current credit on a 3-yr base or longer	1.2	1.1	1.1	1.1

[1] NA—Not applicable. With the full credit and short-lived investments, the effective tax rates become arbitrarily large and negative.

Note: Analytic cases assumptions outlined on p. 8. Minus sign indicates that after-tax returns exceed before-tax returns, resulting in Federal subsidizations.

Source: Congressional Budget Office.

But the credit reduces the cost of doing research by less than tax-rate estimates suggest. Table 2 displays the effects of the credit on the after-tax cost of doing research under the same assumptions used for the results reported in Table 1. For a typical ten-year project in a firm that plans steadily increasing R&D expenditures (see Table 2, Case 1), the tax credit lowers the cost of capital from 18.8 percent to 17.4 percent. By contrast, the full 25 percent value of the credit would have further lowered the research cost to 13.0 percent. But for a firm that is not eligible, such as a new firm in an industry, the credit provides disincentives by raising the cost of R&D from 18.8 percent to 23.2 percent.

(It should also be noted that the government already provided benefits to R&D expenditures before the 1981 tax credit by allowing them to be expensed. If R&D costs were capitalized, not expenses, the cost of doing research would rise to 21.3 percent for a ten-year project.)

Industry R&D spending since the credit

Though total industry R&D has grown in nominal and constant-dollar terms since the credit was passed, it has grown at a decreasing rate. Since 1978, industry R&D has risen at an annual rate of 14 percent in nominal terms. After the credit was passed, however, the annual growth rate has slowed to 11 percent. The recession, which depressed company profits, might have reduced R&D growth rates even further had there been no credit. But no definitive assessment of the credit's effect on R&D activity during that time is possible.

TABLE 2.—USER CAPITAL COSTS OR INDUSTRIAL R&D RESULTING FROM R&D TAX TREATMENT—3 CASE STUDIES

[In percent per year]

Tax policy	Economic life of R&D investment			
	5 yr	10 yr	15 yr	20 yr
Case 1 (base case):				
No credit	28.6	18.8	15.5	13.8
Current credit	26.5	17.4	14.3	12.8
Full credit	19.7	13.0	10.7	9.6
2-yr lag in base period	24.8	16.3	13.5	12.0
Including equipment depreciation	26.4	17.3	14.3	12.8
Expensing R&D capital costs	25.5	17.0	14.1	12.7
Case 2: Current credit on a current-year base	35.4	23.2	19.1	17.1
Case 3:				
Current credit on a current-year base	27.6	18.1	15.0	13.4
Current credit on a 3-yr base or longer	28.6	18.8	15.5	13.8

Note: Analytic cases and assumptions outlined on p. 8.

Source: Congressional Budget Office.

POLICY OPTIONS

With the R&D tax credit's expiration date approaching, the Congress must now decide whether to let it lapse or to extend it, and if the latter, whether in its present form or modified. If the Congress allowed the credit to expire, expensing would still provide a considerable tax advantage for R&D, but the relative advantage would be less than before 1981 and 1982 tax legislation, which greatly reduced tax burdens on other investments. If the Congress wished to change and extent the credit, it could consider three possible changes and one quite different approach: Refocus the credit toward basic and applied research; eliminate or reduce disincentives to R&D; expand the benefits into new areas; and support R&D with direct grants instead of tax preferences, shifting the source from the rervenue to the spending side of the federal budget.

The arguments for expiration are as follows. The prospect of a large budget deficit suggests extreme caution about any revenue-losing measure, especially one of unknown effectiveness. Since most industrial research is for product development, not for basic or applied research, the usual economic arguments for favorable tax treatment are not entirely appropriate. The main argument for renewal in some form is that technological change is a major contributor to economic growth, and without some encouragement for R&D, the marketplace will not devote enough resources to innovation.

Refocusing the Credit

The R&D tax credit now is available for both the development work connected with getting current products to the market and for research on potential future products. Yet it is in basic and applied research that societal and market benefits from R&D are most likely to diverge. Accordingly, one option is to refocus the credit toward basic and applied research. This would help those projects now least likely to receive adequate private support. Such a refocusing would also reduce the cost of the credit while encouraging firms to do the research likeliest to yield the greatest reward to society. By limiting support to a narrower category of R&D, the Congress could increase aid to that category and maintain current, or even reduce, tax revenues losses. It would, however, complicate the problem of policing the credit. It is extremely difficult conceptually to distinguish basic and applied research from development. Attempting to administer such a distinction in tax law would be extremely difficult.

Eliminating the disincentives

As noted earlier, the effective credit rate is often far below the statutory rate, and in some cases, it may actually discourage R&D. These effects result from the interactions between the credit and the base from which incremental R&D is defined. Aside from eliminating the incremental feature (a 4 percent to 6 percent credit applied to all qualified research would be roughly revenue neutral), the most direct ways of reducing this disincentive would be to retarget the qualifying base, "lag" (delay) the base period, or make the credit refundable.

Retarget the base.—The Congress could limit the credit to firms with R&D expenditures—controlled for firm size—greater than an economy-wide or industry-wide average, rather than a firm-specific average as under current law. This modification would eliminate the "feedback" of the base on the credit and increase the credit to its statutory value. For qualifying firms, the cost of doing research would drop by the full amount of the credit—from 18.8 percent to 13.0 percent for a typical ten-year project (see Table 2, Case 1). But amending the credit in this manner would target incentives toward firms that already do more research than do others in their industry, and it would eliminate any incentive for firms doing little research. Defining the relevant industry might also pose problems. And perhaps most important, there would be no guarantee that the R&D undertakings receiving the most encouragement from this approach would be those yielding the greatest benefit for the nation as a whole.

Lag the base.—The firm-specific base could be retained while the credit's disincentives to R&D were reduced by redefining the base as the average of three years ending two years before the current year—that is, by lagging the base period by two years. A lagged base (possibly indexed for inflation) would raise the credit's present value. As noted earlier, the value of the credit to the firm comes through the time value of money. By introducing a lag, the Congress would be increasing the number of years over which the firm could discount the negative aspects of the tax. If the base were lagged two years for the "typical" firm, the cost of doing research for a ten-year project would drop from the current 17.4 percent to 16.3 percent (see Table 2, Case 1). An extreme form of the lag would be to fix the base permanently for each firm at a given three-year average and adjust this permanent base for inflation. In this situation, the credit would increase to its full value. After a few years, however, the credit would cease to be incremental.

In general, though, these changes in the treatment of the base would lessen the credit's negative incentives, which would increase the cost of the credit to the government. They would also expand the windfall element of the credit by rewarding some firms for actions they intended to take regardless of the credit's being available.

Making the credit refundable.—Making the credit refundable would ensure that the firm receives some value from the credit. For a firm with growing R&D expenses, the credit loses half its value if carried forward one year (see Table 2, Case 3), and it has no value if carried forward three years. In 1981, one-fourth of the potential credits went unused. Largely because of limited tax liabilities, research-intensive industries received less of the credit than their shares of R&D would suggest. Alternatively, the base calculation could be modified to ensure that the base was increased only if a credit were actually received. The latter approach would be less costly to the government but not so valuable to firms.

Expanding the benefits into new areas

Proposals have been made that would expand the credit into two new areas: first, to new entrants and second, for equipment depreciation (see Cases 1 and 2, text box on page 8).

New entrants.—At present, only expenditures incurred in carrying on an existing product line are elibible for the credit. Thus, existing firms moving into new business lines and new firms just starting up are not eligible. For these firms, the credit is in fact negative: the expenditures they make count in their future base period calculations but do not earn the credit when they are making the investment. To them, the costs of research will therefore increase from 18.8 percent without the credit to 23.2 percent with the now-negative credit (see Table 2, Case 2). Existing firms entering a new line of business could be made eligible for the credit, and they would then benefit as other firms do. But making start-up firms eligible might not provide them with comparable benefits, since they are not typically profitable in their initial period and have few if any tax liabilities to offset. On the other hand, allowing all R&D spending to qualify for the credit would increase the cost of the credit further and increase the difficulty of policing it.

Equipment depreciation.—As noted earlier, the ITC and ACRS allow equipment investments to receive the present value of expensing. Because depreciation expenses represent a small portion of the R&D effort, their inclusion in the credit would only sligitly lower the cost of doing research, albeit only from 17.4 percent to 17.3 percent (see Table 2, Case 1).

Alternatively, capital purchases could be expensed or granted the same treatment as R&D labor and material costs before enactment of the tax credit. Expensing equipment and structures would reduce R&D costs to 17.0 percent for a typical ten-year project (see Table 2, Case 1).

Support R&D with a direct grant program

Given the complexity of the tax credit, a grant progrm targeted to industry might be more efficient in accomplishing the goal of promoting innovation. The Congress might be better able to target funds directly to R&D projects offering particular social value and to include such spending in the normal budgetary process, as it now does through the National Science Foundation. Removing the credit from the tax system would also somewhat reduce the complexity of the tax code. It should be noted, however, that a system of direct grants for innovation would once again place federal agencies in a position of having to evaluate the technological and commercial prospects of individual research projects. There is no guarantee that they would do a better job if it than firms responding to a tax incentive. A grant program might also have the tendency to reward grantsmanship more than scientific originality and skill.

TEMPORARY VERSUS PERMANENT EXTENTION

The Administration has proposed extending the incremental R&D tax credit for another three years. They argue that experience with the credit has been very short and because of the intricacies involved in such definitions of "qualified research," another Congressional examination is warranted three years after renewal. On the other hand, permanent extension would facilitate firms' developing long-term financial plans. As a result, current and future research might rise more than under a temporary extension.

CONCLUSION

Thus far, Mr. Chairman, my comments have not considered how the R&D tax credit has complicated the tax code. In general, the more the tax system is burdened with credits and special exemptions, the less effective each credit or incentive becomes. This is currently so when companies have so many credits and deductions available that they can completely cancel out their current and future tax liabilities. At the point, tax incentives are no longer effective. In 1981, half of all corporations had no tax liabilities. We have reached the point that our tax system is asked to do so much that it does nothing very well. That includes its fundamental purpose: raising revenues.

The economic incentive of each new credit (or special deduction) is also reduced as other economic activities are offered preferred tax treatment. For example, the availability of the ITC tends to dilute the effect of the R&D credit by making investment in capital equipment comparatively more attractive than if no credit were allowed. As more economic activities are given special treatment, each activity loses its comparative advantage, thereby negating the effects of any one incentive. Furthermore, the proliferation of tax credits, as well as uncertainty about their status, makes the tax code more cumbersome, complicates the investment planning of firms, and can raise the public's perception that the tax system is unfair.

Chairman **RANGEL**. Thank you very much.

I assume what you are saying is the same as what the previous witnesses have said: That it is much too early to determine what benefits, if any, were received from the tax credit.

Obviously, there have been increases in research. However, you can't attribute it directly to the credit. Certainly it is not targeted and we could get a better analysis of what benefits were received if the code provision wasn't as broad as it is in existing law.

There are other methods by which we can possibly single out those industries that we want to make more competitive in terms of grant and direct subsidy. Also, there are those who believe that corporations shouldn't pay any taxes at all. Maybe that makes a lot of sense.

Mr. **PENNER**. The only part of your statement I have some disagreement with is the very last phrase. The reason for not wanting corporations to pay taxes is obviously that the tax system distorts their activities and creates disincentives.

If you try to get them to the no-tax position using credits and deductions, you have the worst of all possible worlds. You have still distorted their activities, but you are not raising any revenue.

While I think one can probably make some good arguments that the corporate tax creates a lot of problems, the last way I would think of getting rid of it would be by simply creating more and more deductions and credits.

Chairman RANGEL. Maybe you can help us. Since you already have the data, if you could pull together the number of credits that are already on the books and project the cost of those credits.

Mr. PENNER. Yes, sir. We do that every year for you.

Chairman RANGEL. I am not asking you to reach any conclusions as to the value of them. I would like to state for the record how professional CBO has been and how dependent we have become on your research.

I hope you have your staff geared up to find ways to raise revenues. If you can get that information to us, I will share it with members of the committee so that they will be able to discuss the information you provide before this year is concluded. We will be indebted to you.

Mr. PENNER. We are always willing to help.

Chairman RANGEL. I have a list of questions that staff has prepared that I will be giving to you. It is my opinion that we just don't have enough information to reach any valid decisions as relate to this credit.

I will submit them to you. Again, as I said, the record will remain open. Thank you so much for your testimony.

Mr. PENNER. You are very welcome.

Chairman RANGEL. Panel one. The Chair now will invite to testify: Dr. Richard Nicholson, Acting Deputy Director, National Science Foundation; Dr. Robert Eisner, William R. Kenan professor of economics, Northwestern University; Dr. Joseph Cordes, associate professor of economics, George Washington University; David Braverman, associate economist, McGraw-Hill Economics, New York.

I think I saw James S. Halpern. Will you be testifying?

Mr. HALPERN. Yes.

Chairman RANGEL. And James S. Halpern, tax partner, Baker & Hostetler, Washington, DC.

I will ask the witnesses to take notice that your entire statements will appear in the record.

You know what we are searching for here. It would be helpful if you could summarize your testimony so that I will be able to ask some of the questions that have been submitted by members of the subcommittee and some by members of the full committee.

STATEMENT OF RICHARD S. NICHOLSON, ACTING DEPUTY DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. NICHOLSON. Mr. Chairman, we appreciate very much the opportunity to testify in these hearings.

I would like, as you suggested, to submit my written statement for the record and provide a brief oral summary for you.

We are not taxed. It is rather that NSF bears immediate responsibility for supporting scientific and engineering research and education conducted primarily at American colleges and universities.

Our deeper responsibility, however, and a shared one, is for the health of the Nation's scientific and technological enterprise. The R&D tax credit, which is something of the order of half to two-thirds of the entire NSF budget, has attracted our attention and interest.

I believe the committee is familiar with the studies of the credit and its effect by Dr. Eisner and Dr. Mansfield, both of whom have been supported through the NSF Division of Policy Research and Analysis.

We work hard at NSF to keep the research supported by that division independent and objective, influenced neither by political considerations nor by any predilections of our own. Thus the conclusions that Drs. Eisner and Mansfield have reached are their conclusions, not conclusions or positions necessarily of the National Science Foundation.

Our views have been informed and influenced by their work, as yours may be as well. You will be hearing from Dr. Eisner in a few moments.

My written statement presents our views under three broad categories.

First, we believe there is in fact a good case for a Federal incentive to stimulate industry research and development such as the R&D tax credit is intended to create.

Second, we do have some concerns that the structure of the credit may detract from the intended incentive.

Third, related measures to encourage industrial support of university science should be sustained and strengthened.

Let me emphasize a few points under each of the three broad categories.

First about the case for Federal incentive, since I believe the case may be quite a lot stronger than many observers realize. The basic argument is that without such an incentive, firms will tend to underinvest in R&D despite the recognition that R&D is essential for their sustained vitality.

This argument relates partly to risk and time. R&D, particularly the long-term fundamental research that is independent of the R&D spectrum, is exceptionally risky for any individual company or for its management.

Moreover, the payoff from such investment can occur 5, 10, or even more years later when current managers may long have departed. So, management may be tempted to underrate R&D in order to limit risks and maximize short-term bottom lines.

Beyond this effect is the problem of inappropriability of some payoffs from R&D investment. Payoffs from most types of investment—for example, capital investment—will be shared with consumers through reduced prices or improved quality, but normally they will not be shared with other producers. With R&D it is different. The firm that performs or pays for R&D cannot normally expect to capture all the producer benefits. New knowledge or new techniques gained will likely get out in one way or another to other firms who will thus get a share. Competition between producers produced by this, witting or unwitting, sharing of technology is then likely to push prices down. That increases benefits that consumers get. The result is that the benefits from R&D to our country and our people as a whole substantially exceed the benefits to the individual firm.

Research in the past, particularly by Dr. Mansfield and his colleagues, has confirmed this idea that the so-called social benefits resulting from innovation often exceed the payoffs to the innovating firm, in many cases by a factor of two or more.

In short, there is a great deal to be said for Federal incentives that encourage industrial R&D, yet let industry, not Government, decide where the increases will be directed. I firmly believe that even under the best conditions Federal officials cannot do nearly as good a job in deciding how increases should be directed.

We do have some concerns about the form and effectiveness of the current credit. First, the creeping base incremental structure which was referred to earlier, creates unintended bottom line outcomes which dilute much of the intended incentive.

Second, the unavailability of the credit to companies without tax liability, particularly new high tech enterprises, destroys the incentives intended for them.

Third, these problems and the alleged insensitivity of R&D investment to reductions in R&D cost may have limited response to the credit in increased dollars spent on R&D.

As for that, though, the dollar response thus far estimated, while lower than the dollar revenue loss estimated, seems strong. Our reasons for that conclusion are detailed in my written testimony.

These concerns deserve further study. I have asked the NSF staff to build on the work NSF has already done by pursuing further research and analysis on these and other concerns about the credit.

We will work with you, your staff, and Treasury to try to make this work as useful as possible as you consider the credit and possible modifications.

We particularly support Treasury's tightened definition for qualifying R&D. Federal incentives are best focused on the research end of the R&D spectrum, because that is where underinvestment is most likely to occur.

Finally, about taxes and industry-university R&D links. Far fewer dollars are involved here. The incentives for industry contributions to university research deserve to be strengthened to the greatest extent that our current budget stringencies will allow.

The dollars are small. Yet the leverage obtained is large at a time when universities are under great pressure and industry-university links show great promise.

As one good example of that fact, let me take the Semi-Conductor Research Corp. It is a consortium of companies. It was created to support basic research and advanced training at universities. The original chairman of the board of the Semi-Conductor Research Corp., Erich Bloch, reported earlier this year:

> The idea for the creation of SRC was developed in 1981, in the wake of enactment of the R&D tax credit. The R&D credit was an important factor in the decision to proceed with the formation of SRC—both because of the positive environment for R&D and university basic research which existed with enactment of the credit and

because of SRC's ability to use the tax credit as a positive sales tool to attract corporate members willing to fund university basic research activities.

If the credit is not extended, the incentive for companies to become members and expand their contributions * * * will diminish.

We agree with Mr. Bloch and believe that the university-related provisions have significantly contributed to the recent remarkable resurgence of corporate support for and links with university science and engineering.

Our written testimony explains why we think that is important and mentions some small improvements in the provisions that might have great value.

In the year to come, Mr. Chairman, the administration and you in the Congress will face very difficult decisions in order to reduce further the budget deficits we are facing. I should like to close by pointing out that the choices we make will have not only direct effect on various national goals, but indirect symbolic effect.

Science and technology can claim immunity from scrutiny and we would claim none for them. Yet your enactment of the R&D credit and related provisions for industry support of university science has helped materially to create the atmosphere from which a surge in industrial R&D and in industrial support for university science and engineering has emerged.

The national commitment to the unique form of long-term investment those enterprises represent must be sustained if this nation and our economy and technology and science are to retain leadership in the world.

This concludes my summary, Mr. Chairman. I will be happy to try to answer questions now.

[The prepared statement follows:]

STATEMENT OF RICHARD S. NICHOLSON, PH.D., ACTING DEPUTY DIRECTOR, NATIONAL SCIENCE FOUNDATION

Mr. Chairman and members of the committee, I am glad for this opportunity to share with the Committee some views on the tax credit for research and development and on other tax credit for research and development and on other tax measures intended to encourage the Nations's scientific and technical enterprise.

The health of that enterprise is the ultimate concern of the National Science Foundation. Our immediate responsibility is to support scientific engineering research and education. We also concern ourselves, though, with legislative and regulatory measures that affect or are intended to affect the country's science and technology base. The R&D tax credit, amounting to something on the order of half to two-thirds the entire budget of the National Science Foundation, certainly falls in this category.

We have concerned ourselves with the R&D credit—and with related tax measures intended to foster industry support for and links with university science—in two ways. First, we have participated as we could in the tax-policy councils of the Administration. Second, we have supported research and analysis on the effects and efficacy of the credit and related measures.

The Committee will be hearing from Dr. Edwin Mansfield and Dr. Robert Eisner, whose research on the credit was supported by our Division of Policy Research and Analysis. We work hard to keep policy research we support independent and objective, influenced neither by political considerations nor by any predilections of ours. Thus the conclusions Dr. Mansfield and Dr. Eisner have reached are their conclusions, not conclusions or positions of the National Science Foundation. We have been informed and our views influenced by their work, as yours may be.

I should like to make two points for your consideration.

First, there is a real case, a strong case, for a Federal incentive to stimulate industrial research and development and we believe that the R&D credit should be extended.

Second, the credit and related measures to encourage industrial support of university science should be sustained and, where possible, strengthened.

THE CASE FOR A FEDERAL INCENTIVE

Congress enacted the tax credit for research and experimentation expenditures to give companies an extra incentive to increase their R&D. This purpose is sound. Otherwise firms will tend to underinvest in R&D is exceptionally risky for any individual company. Much R&D pays off only after five, ten years or more when current management may be long departed. Moreover, its benefits often inure in good part to other companies.

Using a mechanism that encourages increased industrial R&D, yet lets industry, not Government, decide where the increases will be directed is also sound. Federal officials cannot do as good a job at identifying the specific technologies and products likely to make the greatest economic contribution as America's numerous small and large businesses.

We believe that special Federal encouragement of industrial R&D is clearly in the national interest and that the mechanism of a "tax credit" is the right form for this encouragement. I realize that in this we are preaching to the choir. Not only the current R&D credit, but many other recent legislative initiatives and pending bills attest to the strong drive in Congress to bolster the science and technology base of American industrial strength. The R&D tax credit, intended to do just that, thus has attractive features. We hope to see its full promise realized.

PROBLEMS WITH THE R&D CREDIT AND FURTHER RESEARCH

Analysis and research have raised questions and concerns about the efficacy of the current credit. Two major concerns emerge. They are:

(1) That the creeping-base incremental structure of the credit creates unintended bottom-line outcomes which dilute much of the intended incentive.

(2) That these problems and alleged insensitivity of R&D investment to any reduction R&D costs, including the reduction effected by the credit, have limited the response in increased dollars spent on R&D.

Each of these concerns, in our view, deserves further exploration and analysis. We have asked NSF staff to build on the work NSF has already supported by pursuing further research and analysis on these and other concerns about the credit. We will work with you and the Treasury to make this work as useful as possible i your deliberations. We hope that a revised Federal incentive for R&D might do more for the country at no greater revenue loss.

Taking into consideration the structural problems with the present R&D credit and doubts about the cost sensitivity or R&D expenditures, the response to the credit thus far reported seems surprisingly strong. For example, the credit actually claimed last year has been estimated at around $600 million. (Some as yet undetermined additional amount will be claimed in later years under the carryforward provisions.) Dr. Mansfield's first estimate calculates this revenue loss at something on the very rough order of $400 million real increasein industrial R&D. Neither the revenue loss nor the response were large as these things go, but the relationship between the two seems surprisingly positive given the problems with the existing structure.

That the estimated R&D increases are lower than the estimated revenue losses should not surprise or discourage us. I suspect the same thing happens with most "tax" incentives. The proper measure of success is whether the benefits accruing to the country from the increased industrial R&D outweigh the revenue losses of the credit by a sufficient margin.

In the window of a few months before the Administration and the Congress must make further decisions on the future of the R&D credit and of alternative claims on the Federal budget, you will, of course, consider many proposals for restructuring or otherwise revising the credit. One of these is the tightened definition of qualifying R&D that Treasury has suggested and we support. Given the minimal revenue loss that can be afforded in current circumstances, the Federal incentive for industrial research and development should be concentrated toward the "research" end. It is there that companies experience the most difficulty in capturing the producer share of benefits from the R&D investment and are most likely to underinvest.

We hope, however, that neither the problems with the present form of the credit nor the many recommendations for its revision will obscure the main point: That a tax credit for R&D is a sound idea and that it should be extended in some form.

TAXES AND INDUSTRY-UNIVERSITY R&D LINKS

I should like now to turn to a matter involving far fewer dollars, but nonetheless deserving of your careful attention. I refer to proposals that have been made to improve incentive for industrial contributions to university research and science training. The current R&D credit is allowed for research funded at universities in roughly the same way as for research conducted in-house. Section 170(e) of the Code, enacted at the same time, allows an enhanced deduction for manufacturer contributions of scientific equipment to be used in university research. These two provisions have contributed to the recent remarkable resurgence of corporate support for and links with university-based science and engineering.

For one dramatic example, take the Semiconductor Research Corporation. It is a consortium of companies in or related to the pivotal semiconductor industry; it was created to support basic research and advanced training at universities in the scientific and engineering fields that underlie semi-conductor technology. The original Chairman of its Board, Erich Bloch, reported earlier this year that

"The idea for the creation of SRC was developed in 1981, in the wake of enactment of the R&D tax credit. The R&D credit was an important factor in the decision to proceed with the formation of SRC—both because of the positive environment for R&D and university basic research which existed with enactment of the credit and because of SRC's ability to use the tax credit as a positive sales tool to attract corporate members willing to fund university basic research activities."

"If the credit is not extended," he added, "the incentive for companies to become members and expand their contributions . . . will diminish." As it happens, Mr. Bloch has since been named by the President to be the next Director of the National Science Foundation.

NSF has also had occasion to observe effects of the enhanced deduction for corporate donations of research equipment to universities. The contributions of such equipment to our grantees since its enactment have been very substantial. Several companies, wishing to ensure that the equipment they donate supports the most meritorious science, have provided grants or equipment or major price concessions to scientists and engineers whose research has been highly rated by NSF peer reviewers and so have received NSF grants. In Fiscal Year 1984 over $6 million worth of computer donations went to academic researchers through this secondary channel alone.

These boosts to university research and training and to links between industry and university science come at the right time. American universities in recent years have experienced escalating research costs and salary expectations for graduate-trained scientists and engineers in the fields of greatest importance to American industry. One result has been somewhat inadequate laboratory facilities and equipment for training students, for performing state-of-art research, and for retaining research faculty. Another result, exacerbated by the first, has been difficulty in hiring and retaining faculty in computer science and engineering, the fields where they are neded most. These bottlenecks reduce our capacity to train new scientists and engineers. The international competitiveness of our key high-technology industries depends heavily on the quantity and, above all the quality of the scientists and engineers being trained in our universities.

These tax measures apparently have helped to stimulate the recent surge of industry support for university science and engineering. They made it more attractive for industry to contribute. More than that, though, Congressional action signalled the need for industrial as well as political leadership to address this national issue.

The National Science Foundation urges that these two tax incentives be not only retained, but strengthened to the maximum extent that our current budget stringencies will allow. The dollars involved are small. The leverage obtained is large.

In the case of the R&D credit, Treasury has suggested a scheme to eliminate disincentives in the existing law to funding of multiyear university research projects. Others had proposed a differentially larger credit for corporate support of university research and restructuring the university portion to make it nonincremental. These changes should be seriously considered even in this time of fiscal restraint.

In the case of the enhanced deduction for equipment donations we urge, as we have in the past, several worthwhile improvements that Treasury has also either endorsed or not opposed. The proposed extenson to donations of computer software will encourage donors to provide universities with fully operational equipment. Specific inclusion of equipment intended for educaton of students in laboratory situations, as proposed in the Senate version of H.R. 4170, will eliminate uncertainties and let industy help universities develop new scientists and engineers in the teaching laboratory as well as the research laboratory. Elimination of restrictions which deny companies enhanced deductions on scientific equipemnt they market if a large part of actual manufacture has been "contracted out", would erase an esentially irrational distinction unrelated to equipment quality and usefulness.

In the year to come we in the Administration and you in the Congress will face very difficult decisions in order to reduce further the budget deficits we are facing. I should like to close by pointing out the choices we make will have not only direct effect on various national goals, but indirect symbolic effects. Science and technology can claim no immunity from scrutiny, and we would claim none for them. But the gathering of the political will to enact the R&D credit and related incentives for industry support of university science, plus the signal sent by their enactment, helped materially to create the atmosphere from which a surge of industrial R&D and of industrial support for university science and engineering have emerged. The priority they placed on industrial R&D and on university science evidenced and evoked a national commitment to the unique form of long-term investment those enterprises represent. That commitment must be sustained if this Nation and her economy and her technology and her science are to retain leadership in the world.

Chairman RANGEL. How long have you been the Acting Deputy Director of the National Science Foundation?

Mr. NICHOLSON. Two years.

Chairman RANGEL. Are there any documents or papers that recommend any limitations on Federal subsidies for research and development? Directly or indirectly as they relate to tax policy, waste, or abuse?

Mr. NICHOLSON. No, sir, there is none at the National Science Foundation. As you know, we primarily support research to university professors such as my colleague to my right.

Chairman RANGEL. As far as you are concerned, if it is research, it is good? If the research is being used—for example, for fast food or hair designers or fashions—is it your institution's position that the research is basically good, and the more Government can help and encourage it, the better?

Mr. NICHOLSON. I think one does indeed want to see where it is being used and in what ways. It probably is too early to get a fix on it.

Chairman RANGEL. Has there been any area where your Foundation has suggested that perhaps the Congress has just gone overboard in terms of giving assistance to research and development?

Mr. NICHOLSON. No, there is not because, like you, we are not aware of any analogies yet which show precisely how it has been used and how effective it is on different concepts.

Chairman RANGEL. It is just a good concept and should be supported?

Mr. NICHOLSON. We do believe investment in R&D and particularly at the basic end of the R&D spectrum is very important and there is a tendency to underinvest in it even recognizing that it is essential for your own vitality, there is still a tendency to underinvest for the reason I stated earlier.

Chairman RANGEL. The more Government can do to encourage investment——

Mr. NICHOLSON. I think the whole society benefits. Studies show a factor of two on that kind of investment for society as a whole.

Chairman RANGEL. You support the concept that a tax credit which reduces your tax liability by x number of dollars, is a good route which your scientists can live with? Or don't you care how we support it?

Mr. NICHOLSON. It is a better way than trying to have Government officials, even as well intentioned or as good as they might be, to try to target these things themselves. They are not close enough to the market conditions and changes in the R&D environment to do that very well.

Chairman RANGEL. How will we know where the abuses are if they are not targeted? If we continue to provide an across-the-board tax subsidy?

Mr. NICHOLSON. I think we would be in favor of tightening the definition that focuses it more closely on the "basic" end of the R&D spectrum because that is where the underinvestment occurs.

I don't imagine if you tighten the definition, that hair designers would fit in that.

Chairman RANGEL. We have not studied it. There is a contingency out there obviously for it.

Mr. Eisner.

Mr. NICHOLSON. Mr. Chairman, I do have a conflicting appointment. With your permission, could I be excused?

Chairman RANGEL. Yes. Thank you for your continued support.

Mr. Eisner.

STATEMENT OF ROBERT EISNER, WILLIAM R. KENAN PROFESSOR OF ECONOMICS, NORTHWESTERN UNIVERSITY

Mr. EISNER. As Dr. Nicholson has indicated, I have been working for 2 years on a study in depth of what has happened with the incremental credit for research and experimentation.

I should indicate briefly I came to this with some prejudice against various kinds of tax incentives or activities, particularly, for example, against the investment credit. One might well argue that investment is something that should be left to business on its own. Business should invest to the extent it is profitable and the tax system should not be rigged in support of capital expenditures.

When we come to the matter of research and experimentation, research and development, I began, myself, with the view that clearly there is ground for encouraging R&D expenditures and the Government has a role in it.

When I got to work on this credit, my eyes were opened in many ways and I would like to share with you the education that I received.

We think that encouraging R&D is a good idea. I worked analytically in terms of what the whole thing amounts to. We went into the OTA data which have been reported on this morning. I have had access to data the 1981 OTA file and analyzed them. I worked with the Compustat data and actual reports of business on what they spend on R&D, worked from McGraw-Hill data and what they anticipate, and worked with NSF data.

First, the committee has to face the fact that in many ways the current credit is not only not doing much to encourage R&D, but is perverse. It was not intended to be that way. The issue relates to the way the credit is tied to a previous base. If a firm, for example, is below base, if it is spending less than it did previously, it actually has an incentive to lower its expenditures because it can't enjoy the credit anyway if it is going to be below base. It might as well lower expenditures in order to enjoy greater credit in the future.

Second, the 50-percent limitation has the effect of being perverse because the way it works, and this is in my statement in the National Tax Journal article, is that if you are in this over 100-percent growth category, you in effect get only 12½ cents on the dollar of additional R&D.

As a consequence, it pays you if you are in that category to reduce your R&D spending currently. You are losing only 12½ cents currently, and you gain 25 cents in the future. That is the second place where it is actually perverse.

The third place that it could be perverse is if you are in a no-tax category. Many firms now are in a current no-tax category. If they have no carryback, it may pay them not to take the credit now because they can't get any benefits. Rather, lower their base in order to get credit in the future.

So, analytically you can show, if you look at the numbers and the amount of substantial categories, there are large categories of firms in which the current credit as defined is far from likely to be increasing R&D. It is likely, if it has any effect at all, to decrease it.

Now, another aspect which has not been looked into much is the fact that the credit runs contrary to the general notion of good tax policy and fiscal policy in terms of trying to keep the economy on an even keel. Our income tax and corporate tax is such that firms and individuals pay lower taxes in recession and higher taxes in a boom.

You sort of like that. You figure in recession you want to lower taxes and in a boom you would rather have higher taxes.

The R&D tax credit does not work that way because in a recession a firm's R&D will tend to be going down or not going up as much and also because a firm may not be paying as much tax. In a recession the credit will tend to be less.

On the other hand, in the boom when you don't want a bigger credit, the credit will be greater. The credit is tied to nominal expenditures which means the greater the inflation, the greater the credit and that again is something which would be contrary to a wise tax policy.

The next major thing that I would like to get into is what has been called cheating. I would have to differ sharply with the testimony given by the Treasury regarding the lack of evidence that there is any of what we might call creative accounting going on.

I think there the evidence is overwhelming that there is creative accounting. As pointed out in the Treasury testimony and my own similar analysis of the data, in 1981, the one year we have definitive returns on, their calculation of the increase in research and experimentation expenditures over base was some 40.3 percent.

I have gone into great detail in the Compustat data on reports of actual expenditures, made adjustment for the fact that the credit applies only to firms whose expenditures are increasing over base.

The best evidence we have is that the actual expenditures, if they were reported to the Treasury the same way they were reported to SEC, went up 21 percent. There is an increase, according to

Treasury's figures, over 40 percent over base when the actually general, available figures indicated an increase of only 21 percent.

There is apparently a huge amount of new R&D expenditures being found for tax purposes that are not found otherwise.

Now, another thing I might address briefly is the question of extension, whether the credit should be permanent or temporary. Here again you run into a paradox. That is, as we pointed out in our paper, a professional paper and paper to the NSF a year ago, the credit operates in a rather curious way.

It is not really a 25-percent effective credit because it is tied to your base and each time you spend more, now you raise your base for the future. Indeed, if the interest rate were zero and the credit were permanent, there would be no advantage to the credit because all you would be doing is lowering your taxes one year and raising them in future years.

As a matter of fact, since the interest rate is far from zero, there is a benefit, but it is nowhere near 25 percent even in the 60 percent of the cases of firms that are enjoying the full credit because they are not within the restrictions and have tax liabilities.

It turns out to be effectively 4 to 6 percent, depending on rate of interest. That is because you are going to lose your credit in future years because you raise your base for future years by spending more now.

However, if the credit is not going to continue, then you have nothing to lose in the future and you get the full benefit of the credit now.

For example, if the Congress were to go on record and say we have had it, this credit expires as it was supposed to, at the end of 1985, then firms next year, instead of facing an effective credit of only perhaps 4 to 6 percent, stand to gain the full 25 percent. They might as well shoot the works. They have nothing to lose, by increasing their R&D spending next year.

They won't have any future credit to lose because there won't be any future credit.

If they really believe the credit is an incentive as it is supposed to be, there would be a much bigger incentive for the moment if we announced flatly, "We have had it, the credit will not be extended."

That might be of interest on the issue of extension versus letting it ride and doing something else if you wish to try to increase R&D spending or increase innovation.

Now, I might next come to the question of how much it is costing. It is costing plenty. The Treasury's estimates are in some ways misleading in the first place because they are given only for half of 1981.

The nature of the credit is such that the length of the time lag between expenditures and base tends to grow year by year. I have gone through careful estimates on the basis of the record we now have in R&D spending in 1981, 1982, and 1983 on the basis of the McGraw-Hill surveys of anticipated expenditure estimates for the years in the future.

The OTA report for 1981 tells you only the credit claimed against current income, current taxes. But that overlooks the fact that since many firms were not paying taxes in 1981, many of them couldn't take the credit in 1981, but could claim it against back years.

For that reason, their estimate tends to be low. But beyond that the nature of the credit is such that it will tend to increase in future years.

The estimates that I have then are that taking account of the carryback for 1981, the credit is going to cost the Treasury upwards of $800 million; for 1982 about $1.4 billion; for 1983 over $1.6 billion and about a billion and a half generally for the years on ahead.

If you extend it beyond 1985, you are talking about roughly a billion and a half dollars Treasury tax loss each year and that is for a credit for which, as will be explained a bit more briefly, I can find no discernible evidence of positive effect on R&D.

It is true that R&D spending has gone up, but it goes up every year. According to the Treasury claim, it has gone up tremendously, but it is not borne out by the record of either business' financial statements or NSF or anybody else.

I might just mention a bit on effectiveness. It is hard to measure the effectiveness, it is true, because of the curious nature of this credit in that it is tied to the growth in R&D. Clearly, of course, the bigger the credit, the bigger the growth in R&D.

That is because you are getting the credit for growth in R&D. There are some things we can do and one of them is to try to relate the growth in R&D or R&D spending itself to the extent to which credit can be used.

Because of the limitations, there is a difference between the credit, so-called tentative credit, as the Treasury calls it, and credit available because the firm may be in a 100-percent limitation, the firm may not have tax liability.

Where the firm is unable to claim the credit, it is actually spending less than where it is able to claim the credit. While I can't say the analysis is exhaustive, from various tests we have done, we have as yet discerned no significant effect of the credit by that kind of fairly subtle measurement.

Chairman RANGEL. Could you hold your point? I have to vote. We will take a break for 15 minutes. After that we will have the last panel here.

I think we should break for lunch after this testimony. We will finish the testimony of this panel and then we will recess until 1:30 before we take the testimony of the last panel.

Would that cause any inconvenience for those who will be on the last panel?

I will be back in 15 minutes.

[Recess.]

Chairman RANGEL. When we recessed, we were listening to Dr. Eisner.

Mr. EISNER. Yes. Thank you very much, Mr. Chairman. I was actually near the conclusion of my remarks.

I might indicate that, as you can gather from the material in my presentation here and certainly in the formal statement for the record, I have considerable doubt as to the value of the tax credit. I think there is some question as to whether one should proceed in this fashion at all in the interest of furthering research and innovation.

It may well be that the path to take is direct Government support for research, either the direct conduct of research or support of nonprofit institutions and research institutes. If one is to support business and encourage business in research expenditures, that had better be done by direct subsidy, in which the expenditures are above-board and we know just what they are and can more clearly target them to whatever purposes seem socially desirable.

However, I should say that, having examined this credit, I can suggest ways in which, if it were to be extended, it could be made more effective, and these involve the following:

For one thing, while it seems as if you are somehow saving the taxpayer, I think you are not, with this 100-percent limitation. You would do better to eliminate it, in that all it does is create this rather reduced expansion effect at best and a perverse effect at worst. If you want more R&D, you want it whether it is a lot or a little, and if you cannot make sure you are getting real R&D anyway then it does not make much sense to say, we are going to give a credit for a 90-percent increase but not much for over 100 percent.

The 100-percent limitation, while of no great moment, actually tends to limit the effectiveness. However, I could add, you can make it a direct subsidy and you can also make it refundable, to get around the problem of not encouraging firms who do not have tax liabilities.

But the biggest particular change that might be considered would be to get away from the company-specific base, which is what vastly reduces the incentive effects of the credit and tends to make it in many cases perverse. I think the idea of an incremental credit is good. You are trying to avoid giving firms credits for doing what they would do anyway, and the idea is you give them credit only for increasing their spending. That is sound.

However, by saying that you give them the credit only for increasing their spending over a base in terms of their own expenditures, the problem, as I suggested, is that each time they spend more now they get a credit for it, but they increase their base for the future, because their base for the future is based on these expenditures they are making now, and therefore they lose that credit in the future.

The thing to do is to give them the carrot, try to make them spend, but not penalize them for the spending and also not reward them for what they would do anyway. That means that what you might well do is to say, all right, you start with a base, for example, if you are going to extend it. The base for each company is the average of these expenditures for 1983, 1984, and 1985.

But now in 1986 they will be told, if it were extended, that whatever base they have will now go up year by year, not on the basis of their own spending, but let us say on the basis of the industry average or even the economy-wide average. That means each firm by increasing its spending is in effect truly lowering the base for everybody else, but not significantly affecting its own base.

So that, then, would be the way to go to preserve the incremental character of the credit and therefore get the maximum bang for the buck, without all of these disincentive effects. I say that as a technician, if you wish, suggesting how you could improve the credit if you want to improve it.

But I guess I should close with my bottom line from my statement, that whether the credit should be extended in any form is another matter. Given the concern about mammoth structural deficits in the years ahead, this committee and the Congress might well wish to avoid action that would add perhaps another $1.5 billion annually to that future deficit, with little or no payoff.

Chairman RANGEL. Thank you, doctor.

[The prepared statement and a study follow. Oral testimony continues on p. 157]

STATEMENT OF ROBERT EISNER, WILLIAM R. KENAN PROFESSOR OF ECONOMICS, NORTHWESTERN UNIVERSITY

I am happy to have this opportunity to report on a substantial body of research into effects of the incremental tax credit for R and D enacted in 1981. The work has had the financial support of the National Science Foundation which is, of course, however, in no way responsible for the particular content of our analysis.

I shall keep this statement relatively brief and urge the attention of the Committee to the larger report that I presented with Steven H. Albert and Martin A Sullivan, "The New Incremental Tax Credit for R & D: Incentive or Disincentive?," in the June 1984 issue of the National Tax Journal. Mr. Sullivan, I should add, has worked closely with me in preparing additional data included in the current presentation.

First, by way of introduction, a strong argument can be made for government policies to encourage R and D spending.

In general, commitment to a competitive, free-market system dictates a minimum of government intervention. More than most seem to realize, this argues, for example, against tax subsidies or incentives for business investment. In principle, business will invest in what it finds profitable. Companies should not be offered special tax advantages to invest in what otherwise does not appear profitable.

R and D, though, is another matter. To the extent that benefits of R and D inevitably flow outside of firms undertaking it, each individual company will attempt to underspend on R and D, undertaking only those expenditures for which its own likely benefits exceed its costs.

Accepting the principle that government policy should be designed to bring about more research and experimentation does not answer the question of whether tax incentives in the current law are effective and in what form, if at all, they should be extended.

Let me undertake to summarize the analysis and findings we have reported in the National Tax Journal and supplement these with some of the latest results of our continuing analysis of a Treasury file on tax returns, Standard and Poor's Compustat data for R and D and related variables, and regular surveys by McGraw-Hill along with a special McGraw-Hill survey undertaken on our behalf.

(1) The new incremental tax credit for R and D has a limited potential for stimulating expenditures, and in some cases actually discourages them.

(2) The credit is pro-cyclical and sensitive to inflation.

(3) An initial surge in credit claims arises from shifts in the proportions of R and D deemed qualified rather than increases in total R and D.

(4) Allowing the current credit to die at the end of 1985, as provided in current legislation, would paradoxically offer more incentive to R and D expenditures over the next year than would extending it or making it permanent.

(5) From 1983 to 1985 the credit is likely to cost some $1.5 billion annually, exceeding initial Treasury estimates.

(6) A number of modifications to the credit would increase its incentive effects; the most important of these would redesign the firm-specific moving-average base so that increases in current expenditures would not reduce future credits.

On purely analytical grounds, the potential of the credit in its current form can be shown to be substantially limited. First, the credit clearly offers no tax benefit and no incentive to firms whose R and D is below the base established by its previous R and D expenditures. In fact, such firms, if they use the law to their best advantage, will be induced to *reduce* their current R and D spending in the hope that by lowering their base for the future they can enjoy a tax benefit later.

Second, firms already planning to increase R and D spending by more than 100 percent of base actually enjoy a credit of only 12 and one-half percent rather than the nominal 25 percent on any additional R and D spending. This result stems from the provision that for such firms the base becomes 50 percent of actual expenditures. Thus, an additional dollar of R and D spending, increasing the base by 50 cents, increases the excess over base by only 50 cents. The credit of 25 percent applied to this 50 cents excess amounts to only 12.5 cents on the increased dollar of R and D spending.

Firms in this category as well then have some incentive to reduce their current R and D spending. For they would be better off getting their current spending down to a level that constitutes no more than a 100 percent increase over base. They would be losing only 12.5 cents per dollar of reduced R and D spending in terms of current taxes, but might hope to gain 25 cents in future tax benefits by thus lowering their base for the future.

Third, many firms had increase in R and D spending which would make them eligible for a full 25 percent tax credit but have no tax liabilities against which to apply the credit. Unless they have had such liabilities over the past three years they gain nothing from the carry-back provision, and indeed no gain at all if tax liabilities are not anticipated over the next three years.

Fourth, and perhaps most important, the particular form of the current provision, relating the credit to increases in the firm's qualified R and D expenditures over a base calculated from its own previous expenditures, greatly reduces the incentive effects of the credit. For what it means, simply enough, is that firms which are induced by the credit to increase current R and D expenditures save current taxes, but they correspondingly reduce their anticipated tax credit in the future. Thus, firms anticipating generally increasing R and D expenditures (whether real increases or increases due to inflation) must reckon their benefits only in terms of postponing taxes over a three year period rather than reducing them. Since $12 of increased R and D spending would then reduce taxes by $3 in the current year but raise them one dollar in each of the succeeding three years, the tax benefit to the firm is the difference between $3 and the sum of the present values of one dollar in each of the next three years. For firms with a 10 percent rate of discount, for example, the nominal tax credit of 25 percent is reduced to an effective credit of 4.3 percent. With higher rates of interest of discount, the effective rate is somewhat higher, but still generally far below the nominal 25 percent rate.

These last considerations become critically relevant with reference to extension of the tax credit beyond 1985. If firms did not contemplate a credit for future increases in R and D expenditures, there would be greater advantage to increasing research and experimentation now. For the additional tax credits or reductions in taxes now as a consequence of increased spending would then not be matched by future reductions in credits.

If firms had been certain in 1983 that the credit would in fact expire at the end of 1985 they would have reasoned that increased expenditures in 1983 could result in reduced credits only in 1984 and 1985. The effective rate of credit of 4.3 percent, with a 10 percent discount rate, that we have just calculated for the firm anticipating the possibility of credits in three future years would then become 10.5 percent. In 1984, increased expenditures for R and D would result in reduced credits only in 1985, and the effective rate of tax credit for expenditures in 1984 would be 17.4 percent. And finally in 1985, the last year of the credit, firms would have every incentive to increase R and D spending, knowing that they would enjoy a full 25 percent effective credit that year (if R and D were less than 100 percent above base and there were current tax liabilities against which the credit would be applied), since there would be no future years during which credits would be reduced because of increased current spending.

Thus, from the standpoint of incentives for greater R and D spending between now and December 31, 1985, it would be better to make clear that the current credit will not be extended or made permanent.

We can begin to give flesh to this analytical framework by analyzing special tabulations of 1981 tax returns prepared for us by the Office of Tax Analysis of the Treasury. These indicate "total qualified research expenses" of $13.44 billion, a "tentative credit" of $872 million, and a credit actually claimed of $630 million, as shown in Table 1. The last, lesser figure reflects a lack of current tax liabilities against which to offset the credit, the shortfall of credit claimed amounting to almost 28 percent of the tentative credit.

Further, of the $13.44 billion of total qualified research expenses, some $1.24 billion, or 9.2 percent, were undertaken by firms whose reported qualified R and D was more than 100 percent above the base figure so that they were receiving only a twelve and one-half percent credit at the margin, as can be seen in Table 2. Thus only 63.2 percent of total qualified R and D expenditures of those calculating a tentative credit in the R and D tax file were incurred by firms in a position to claim the full credit (defined as 99 percent or more of a full 25 percent credit). And this does not take into account the some 6 percent of expenditures, according to our Compustat data, undertaken by firms who would not have filed for the tentative credit because their 1981 expenditures were below their 1980 base expenditures.

Comparison of the OTA data for 1981 with data from the Compustat tapes, from McGraw-Hill and from the National Science Foundation tabulations reveals some striking and informative differences. Total company funds for R and D grew by 16.2 percent from 1980 to 1981 according to NSF and 14.1 percent in the Compustat data. Restricting the Compustat firms to those with positive R and D growth, to make them comparable to the OTA sample, we still get a growth over base of only 21 percent, as against the 40.3 percent growth in the OTA sample. There is clearly a strong implication that many business taxpayers were indulging in creative accounting, classifying as qualified research and experimentation expenditures in 1981 activities which were not included in calculating the 1980 base. Tax credits were claimed on alleged increases in R and D which were some double other presumably reliable measures of the increases of R and D which actually occurred.

The Compustat data for 1981 indicate a much larger proportion of R and D undertaken by firms with R and D greater than base for which there was some federal tax liability against which the credit could be claimed. This came to 80.7 percent of total expenditures in 1981. Interestingly that same proportion, as indicated in Table 3 of our National Tax Journal article was down to 52.7 percent in 1982, as a consequence of both declining growth in R and D and lower tax liabilities.

This last points up the pro-cyclical nature of the R and D tax credit. In recessions, R and D expenditures, like all other expenditures, tend to slacken. Since the credit is tied to the rate of growth of R and D expenditures, it is particularly sensitive to such a slackening. Thus a decline merely in the rate of growth over base from, say, 12 percent to 6 percent would cut the credit in half.

Further, with more firms suffering losses in a recession, tax liabilities against which the credit may be claimed are less numerous. On both counts, therefore, the R and D tax credit tends to be lower in recession when tax reductions would appear particularly desirable to stimulate the economy, and higher in booms when a tighter tax policy might appear useful to prevent inflationary excesses. Indeed, since the credit relates to increases in nominal R and D expenditures, inflation serves to increase the credit and reduce taxes, again the opposite of what would be indicated by appropriate counter-cyclical policy.

A year ago, working with data from Compustat, McGraw-Hill and NSF, we presented estimates of the tentative credit for 1981 ranging from $442 million to $684 million, all very considerably higher than earlier Treasury and Joint Congressional Committee on Taxation estimates. But even our figures have proved substantially low in light of the very great increase in the "eligibility ratio" or ratio of qualified R and D expenses to total R and D, which apparently took place in 1981.

The 1981 credits were of course low because they applied only to R and D expenditures after June 30. Credits for later years could easily be projected at considerably higher levels, generally one billion dollars and more for each of the years from 1982 through 1985.

We are now able to present a set of updated estimates of Treasury revenue losses for 1981, 1982 and 1983, projected losses for 1984 and 1985 and, if the credit is extended in its current form, projected losses for 1986 and 1987. The estimates begin with analysis of a now presumably reasonably complete OTA file of returns of form 6765, Credit for Increasing Research Activities, for 1981. Comparison of "qualified research expenses" reported to the Treasury and reported R and D in the Compustat data permit us to calculate "eligibility ratios" of R and D used in calculating bases and totals for tax credit purposes with R and D reported on financial statements. We can then tie the Compustat data to McGraw-Hill's survey results of R and D in 1982 and 1983 and anticipated changes in R and D from 1983 to 1984 and from 1984 to 1987, to project tax credits in future years.

As shown in Table 1, the OTA file now indicates a tentative credit of $872 million for 1981, of which 72 percent or $630 million could be claimed against current tax liabilities. The great bulk of the credit, as seen in Table 3, goes to very large firms, over 75 percent or $660 million of the tentative credit to companies with more than one billion dollars in assets.

The credit claims to the Treasury were apparently held down significantly in 1981 by the amount of R and D, over nine percent, reported by firms calculating increases of more than 100 percent over their 1980 base period. The actual R and D reported in financial statements and listed in the Compustat tape does not show such a concentration of extremely high growth. Thus, when we apply common eligibility ratios for all firms, calculated so that estimated R and D for the second half of 1981 as well as base figures for 1980, for firms with R and D over base, are equal to the OTA totals, the credits calculated from the Compustat data are somewhat higher. Accepting this minor discrepancy, we may note in Table 4 that the Compustat-calculated tentative credit of $935 million in 1981 would rise to $1,474 million in 1982 and $1,775 million in 1983. Lacks of sufficient tax liabilities, against which the credit may be offset, reduces the credit currently available to $784 million in 1981, $934 million in 1982 and $1,416 million in 1983. Allowance for the potential three-year carryback, however, brings the credit available back close to the tentative credit, or to $888 billion for 1981, $1,395 million for 1982 and $1,688 million for 1983. Aa may be noted in Tables 5 and 6, the credits again are highly concentrated among large firms.

In Tables 7 and 8 we may see the distribution of both qualified R and D and the credit by the growth categories distinguished in the legislation. The Compustat data indicate only small proportions of R and D undertaken by firms reporting increases of more than 100 percent over base. We may infer that the large proportion in this category in the 1981 OTA file is a one-time phenonomen of firms suddenly discovering vast amounts of qualified R and D expenses in 1981 with little or nothing so listed for the base period of 1980.

The 2.6 percent of 1981 qualified R and D undertaken by firms reporting research expenses less than those in the base period, and hence not eligible for any credit, grew to 7.4 percent in 1982 and 8.1 percent in 1983 according to Compustat data with eligibility ratios calculated to conform to tax returns.

Table 9 indicates, for those firms for which current and back tax data were available, the portions of R and D undertaken by "takeup class," that is, class determined by the extent to which firms had current tax liabilities to which research and experimentation credits could be applied. In 1982, as may be seen in Table 10, some 41 percent of R and D was in the zero takeup class, that is, was undertaken by firms who could claim no credit against current taxes because they were not paying current taxes. That figure was sharply lower but still a substantial 22.9 percent in 1983. However, the carryback provision had a major effect, as may be seen in Table 9, in that while no credit could be claimed against current taxes in this zero takeup category, 85 percent of the tentative credit coud be claimed on the basis of carryback in 1982, and 76 percent in 1983. For all categories, the percentage of tentative credit which could be claimed rose from 63.4 percent to 94.7 percent on the basis of carryback for 1982, and from 79.8 percent to 95.1 percent for 1983.

Tables 11, 12, and 13 offer breakdowns of some of this information by industry, for the years 1981, 1982, 1983, respectively. Tables 14 and 15 offer projections, from the McGraw-Hill surveys, of qualified R and D and the tentative credit for the years 1984 through 1987. These, of course, can be no better than the information from McGraw-Hill respondents on which they are based. They suggest though, as might be expected, that the incremental tax credit for research and experimentation will continue to be costly to the Treasury in 1984 and 1985, and on into the future if it is extended or made permanent. We project, as may be seen in Table 14, tentative credits of $1,702,000 in 1984, $1,544,000 in 1985, $1,539,000 in 1986 and $1,618,000 in 1987. While substantial portions of these tentative credits will not be available for each year's current tax return because of lack of current tax liabilities, the carryback provision, as we have noted, is likely to keep the full cost to the Treasury in each year not too far below the tentative credits we are projecting.

We are continuing our efforts to ascertain what effect the incremental credit for research and experimentation has in stimulating R and D spending. As noted above, the nature of the credit is such as to inspire doubt as to its effectiveness. Our examination of the data thus far has done nothing to dispel that doubt, although it is fair to say that definitive analysis is difficult, in part because the credit is calculated on the basis of growth in R and D. Hence R and D surely grows more rapidly when and where the credit is greater but that gives us no clue as to whether the credit is stimulating the R and D expenditures on which it is based.

Our analysis is also slowed by lack of current tax data. Up to this time we have only been able to analyze the Treasury tax data bearing on the credit in 1981 when, of course, it was in effect for just half a year. It might be argued that an impact would be found in later years when the credit was available for all 12 months of expenditures and when firms had a chance to alter their plans to fit the new legislation.

Our main approach in analysis thus far has been to relate R and D spending to whether or not the credit was actually available. By this line of reasoning, for example, we should expect firms with R and D well below base to have no incentive to increase R and D because they would not be likely to increase it enough to enjoy a tax credit anyway. In earlier analysis, reported last year, we could find no evidence of changes in behavior of firms with R and D below base and firms with R and D above base as between years before the credit was in effect and the years from 1981 on.

Similarly, working with the current 1981 OTA file, we have endeavored to note the effects of takeup class and growth class on R and D. We might expect that, if the credit were effective, R and D would be greater, other things given, where firms had tax liabilities to which the credit might be applied. As may be seen on Table 1, though, and as we have found in more sophisticated analysis which we plan to discuss in subsequent report, we can find no evidence that the availability of the credit has increased R and D spending or that its lack of availability has discouraged it. It must be confessed, however, that this analysis of the OTA data may be defective because the OTA file has no information on carryback. Hence our measure of credit availability may be seriously flawed.

We have endeavored to correct for this in analyzing Compustat data by year to see whether the ratio to tentative credit of credit claimed including carryback has some positive impact on R and D spending or, more subtly, the difference in effect of that variable calculated for years when the credit was not in effect, and hence could have no significance, and calculated for the years 1981 through 1983. Again, our statistical results offered no suggestion that the credit was having any positive effect.

One thing that is clear is that the credit for research and experimentation is costing the Treasury substantial amounts of revenue, well over a billion dollars per year. The annual loss has been growing rapidly and will continue to grow, if more slowly, if the tax credit is extended. Yet analytical considerations, now supported by some data, raise serious questions as to whether the credit is doing much, if anything, to realize its ostensible goal of increasing investment in research and development.

As we indicated at the outset, the presumption that more R and D spending may be desirable could not extend automatically to the conclusion that any particular tool is effective or desirable. One may even question whether support for research and experimentation should depend upon subsidies to business rather than on direct government action or support of nonprofit universities and research institutes. Much current research, in agriculture, in defense and in basic sciences is, after all, not done by private business. Perhaps support for non-business R and D would be more fruitful, with business left to concentrate on R and D spending which seems profitable without special tax incentives.

If we do decide to go further on the route of encouraging business R and D spending, certain revisions of the current credit might increase its effectiveness.

First, we might do well to eliminate the 100 percent limitation. While it does not apparently relate to a large proportion of R and D, its negative incentive effects can be considerable where it does come into play.

Second, the credit might best be made refundable or converted into a direct subsidy. Aside from being aboveboard and allowing the Congress and the public to see clearly what the government encouragement of R and D is costing, a direct subsidy would free government support from the sometimes capricous effects of a tax system which is already so saddled with "incentives" which may less charitably be dubbed loopholes. Clearly, the current provision discriminates against firms without tax liabilities, either because, perhaps, they are new and still growing rapidly or because of low profits or substantial indulgence in other tax-reducing activities and accounting.

Third, while retaining the incremental nature of the credit—which may in principle allow it to have a greater "bang for the buck"—we should eliminate the company-specific movements of the base. It is this feature which results in firms generally losing dollar for dollar in future credits the amounts that they gain in current credits from increasing their R and D expenditures, and actually encourages some firms to reduce their R and D.

This provision could be changed by having a company-specific base but leaving it fixed at, say, the average of 1982, 1983 and 1984 qualified R and D expenditures (with possibly some exceptions or adjustments for new firms).

This would imply rapidly growing amounts of R and D credits over the years but would mean that the effective rate of credit would be equal to the statutory rate, and would eliminate any incentive from the credit to reduce R and D.

Somewhat more complicated to administer, but less costly in terms of tax revenues, would be a provision to start with a company-specific base but to adjust that base in accordance with national or industry movements in R and D. Thus, if a firm were in an industry where R and D in 1983 grew by 10 percent, its base in calculating its tax credit for 1984 would be raised by 10 percent. A firm's increased expenditures would contribute to raising the base and reducing future credits for all firms in the industry, but would have a trivial effect in raising its own base and reducing its own future credits. Having the base depend on industry behavior rather than company-specific behavior would achieve maximum incentive impact with minimal Treasury tax loss.

Improvements along these lines would seem imperative if an R and D credit of any form is to be extended. Whether it should be extended in any form is another matter. Given the concern about mammoth structural deficits in the years ahead, this Committee and the Congress might well wish to avoid action that would add perhaps another one and one-half billion dollars annually to that future deficit, with little or no clear payoff.

TABLE 1.—QUALIFIED R&D (QRD), BASE, TENTATIVE CREDIT AND CREDIT CLAIMED, BY TAKEUP CLASS, OTA FILE, 1981

[Dollars in millions]

Takeup class	QRD	Base	QRD/base −1 (percent)	Tentative credit (TENT)	Credit claimed (CRCL)	CRCL/TENT (percent)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Full	$9,221	$6,576	40.2	$602	$600	99.6
Partial	1,416	995	42.3	95	30	31.8
None	2,803	2,011	39.4	175	0	.0
Total	13,440	9,583	40.3	872	630	72.2
Partial plus none	4,220	3,006	40.4	270	30	11.2

TABLE 2.—QUALIFIED R&D CREDIT CLAIMED, BY TAKEUP CLASS AND GROWTH CLASS, OTA FILE, 1981

[Millions of dollars, percent of total in parentheses]

Takeup class	Growth class		
	Low (less than 100 percent over base)	High (100 percent or more over base)	Total
(1)	(2)	(3)	(4)
A. Qualified R&D:			
Full	8,497	724	9,221
	(63.2)	(5.4)	(68.6)
Partial	1,251	165	1,416
	(9.3)	(1.2)	(10.5)
None	2,454	350	2,803
	(18.3)	(2.6)	(20.9)
Total	12,201	1,239	13,440
	(90.8)	(9.2)	(100.0)
B. Credit claimed:			
Full	510	89	600
	(81.0)	(14.2)	(95.2)
Partial	24	6	30
	(3.9)	(0.9)	(4.8)
None	0	0	0
	(0)	(0)	(0)
Total	535	95	630
	(84.9)	(15.1)	(100.0)

TABLE 3.—QUALIFIED R&D, BASE, TENTATIVE CREDIT AND CREDIT CLAIMED, BY ASSETS CLASS, 1981

[Dollars in millions; percent of total in parentheses]

Assets class (1)	QRD (2)	Base (3)	QRD/Base − 1 (percent) (4)	Tentative credit (TENT) (5)	Credit claimed (CRCL) (6)	CRCL/TENT (percent) (7)
		A. OTA				
Zero	$62.2	$47.3	31.5	$3.2	$1.6	50.5
	(0.5)	(0.5)		(0.1)	(0.3)	
Under 1	$214.4	$67.1	219.5	$24.6	$10.0	40.6
	(1.6)	(0.7)		(2.8)	(1.6)	
1 to 9	$720.5	$352.2	104.5	$68.0	$37.5	55.2
	(5.4)	(3.7)		(7.8)	(6.0)	
10 to 49	$566.9	$326.7	73.5	$50.1	$35.3	70.4
	(4.2)	(3.4)		(5.7)	(5.6)	
50 to 99	$313.4	$200.9	56.0	$24.7	$18.9	73.4
	(2.3)	(2.1)		(2.8)	(3.0)	
100 to 499	$1,149.1	$810.5	41.8	$78.7	$52.1	66.1
	(8.5)	(8.5)		(9.0)	(8.3)	
500 to 999	$903.0	$640.3	41.0	$62.6	$40.2	64.3
	(6.7)	(6.7)		(7.2)	(6.4)	
1,000 to 4,999	$4,092.2	$3,017.0	35.6	$353.3	$189.8	53.7
	(30.4)	(31.5)		(40.5)	(30.1)	
5,000 to 9,999	$1,528.7	$1,177.3	29.8	$87.4	$55.4	63.4
	(11.4)	(12.3)		(10.0)	(8.8)	
10,000 and over	$3,889.8	$2,943.4	32.2	$219.5	$189.2	86.2
	(28.9)	(30.7)		(25.2)	(30.0)	
Total	$13,440.1	$9,582.7	40.3	$872.1	$629.9	72.2
	(100.0)	(100.0)		(100.0)	(100.0)	
		B. OTA AND COMPUSTAT COMPANIES				
OTA:						
Under 1	$276.6	$114.4	141.8	$27.8	$11.6	41.8
	(2.1)	(1.2)		(3.2)	(1.8)	
1 to 9	$720.5	$352.2	104.5	$68.0	$37.5	55.2
	(5.4)	(3.7)		(7.8)	(6.0)	
10 to 99	$880.3	$526.6	66.9	$74.8	$54.2	72.4
	(6.5)	(5.5)		(8.6)	(8.6)	
100 and over	$11,562.7	$8,588.5	34.6	$801.5	$526.6	65.7
	(86.0)	(89.6)		(91.9)	(83.6)	
Total	$13,440.1	$9,582.7	40.3	$872.1	$629.9	72.2
	(100.0)	(100.0)				
Compustat: [1]						
Under 1	$23.5	$20.5	14.5	$1.4	$1.1	78.6
	(0.2)	(0.2)		(0.1)	(0.1)	
1 to 9	$459.5	$327.6	40.3	$33.9	$27.2	80.2
	(3.3)	(3.3)		(3.6)	(3.4)	
10 to 99	$2,861.5	$2,033.8	40.7	$212.4	$171.4	80.7
	(20.7)	(20.3)		(22.4)	(21.6)	
100 and over	$10,448.6	$7,658.4	36.4	$699.5	$593.9	84.9
	(75.8)	(76.3)		(73.9)	(74.9)	
Total	$13,793.1	$10,040.2	37.4	947.1	$794.2	83.7
	(100.0)	(100.0)		(100.0)	(100.0)	

[1] Assuming eligibility ratios of .6372 for 1980 and .7237 for 1981.

TABLE 4.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT AND CREDIT AVAILABLE,[2] WITH AND WITHOUT CARRYBACK

[Compustat data; dollars in millions]

	Number of firms	QRD	Base	QRD/base−1 (percent)	Tentative credit (TENT)	Credit available		CRAVC/TENT (percent)	CRAVB/TENT (percent)	CRAVB/QRD (percent)
						Current (CRAVC)	With carryback (CRAVB)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Year:										
			Reporting Firms							
1981	760	$13,793	$10,040	37.4	$947	$794	$899	83.9	95.0	6.5
1982	743	28,323	22,675	24.9	1,474	934	1,395	63.4	94.7	4.9
1983	555	27,651	21,870	26.4	1,585	1,265	1,507	79.8	95.1	5.5
			Normalized to 1982							
1981		13,615	9,911	37.4	935	784	888	83.9	95.0	6.5
1982	743	28,323	22,675	24.9	1,474	934	1,395	63.4	94.7	4.9
1983		30,965	24,492	26.4	1,775	1,416	1,688	79.8	95.1	5.5

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[1] Based on eligibility ratios of .6372 for 1980, .7237 for 1981 and .725 for 1982 and 1983.

[2] Numbers of firms with tax data necessary for "credit available" calculations were 599 in 1981, 586 in 1982 and 445 in 1983. Credits available were blown up by the ratios of tentative credit grand totals or category totals for the larger and the smaller sets of firms in calculations for this and subsequent tables.

TABLE 5.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT AND CREDIT AVAILABLE, WITH AND WITHOUT CARRYBACK, COMPUSTAT DATA, BY ASSET SIZE CLASS

[Dollars in millions]

Asset size class (1)	Number of firms (2)	QRD (3)	Base (4)	QRD/base − 1 (percent) (5)	Tentative credit (TENT) (6)	Credit available: Current (CRAVC) (7)	Credit available: With carryback (CRAVB) (8)	CRAVC/TENT (percent) (9)	CRAVB/TENT (percent) (10)	CRAVB/QRD (percent) (11)
1981										
Under 1	120	$24	$21	14.5	$1	$1	$1	78.6	9.2	4.2
1 to 9	304	459	328	40.3	34	27	31	80.2	91.2	8.1
10 to 99	232	2,862	2,034	40.7	212	171	201	80.7	94.5	7.0
100 and over	104	10,449	7,658	36.4	699	594	666	84.9	95.3	6.4
Total	760	13,793	10,040	37.4	947	793	899	83.7	95.0	6.5
1982										
Under 1	120	42	43	−2.4	2	1	2	77.4	87.3	3.8
1 to 9	304	905	752	20.3	46	32	41	69.2	90.0	4.6
10 to 99	232	5,974	4,671	27.9	340	209	316	61.6	93.0	5.3
100 and over	87	21,402	17,208	24.4	1,086	691	1,036	63.6	95.3	4.8
Total	743	28,323	22,675	24.9	1,474	934	1,394	63.4	94.6	4.9
1983										
Under 1	59	25	24	5.9	1	1	1	88.8	88.0	4.9
1 to 9	227	786	648	21.3	43	28	36	66.0	84.1	4.6
10 to 99	193	5,421	4,422	22.6	292	212	260	72.7	89.1	4.8
100 and over	76	21,418	16,777	27.7	1,249	1,019	1,207	81.6	96.7	5.6
Total	555	27,651	21,870	26.4	1,585	1,261	1,504	79.6	94.9	5.4

[1] Based on eligibility ratios of .6372 for 1980, .7237 for 1981, and .725 for 1982 and 1983.

TABLE 6.—QUALIFIED [1] R&D, BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, CURRENT AND WITH CARRYBACK, BY ASSET SIZE CLASS, AS PERCENT OF TOTAL

Asset size class	Percent of firms	Qualified R&D (QRD)	Base	Tentative credit (TENT)	Credit available	
					Current (CRAVC)	With carryback (CRAVB)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1981						
Under 1	15.8	0.2	0.2	0.1	0.1	0.2
1 to 9	40.0	3.3	3.3	3.6	3.4	4.1
10 to 99	30.5	20.7	20.3	22.4	21.6	22.3
100 and over	13.7	75.8	76.3	73.9	74.9	74.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
1982						
Under 1	16.2	.1	.2	.1	.1	.1
1 to 9	40.9	3.2	3.3	3.1	3.4	2.9
10 to 99	31.2	21.1	20.6	23.0	22.4	22.7
100 and over	11.7	75.6	75.9	73.7	74.0	74.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
1983						
Under 1	10.6	.1	.1	.1	.1	.1
1 to 9	40.9	2.8	3.0	2.7	2.2	2.4
10 to 99	34.8	19.6	20.2	18.4	16.8	17.3
100 and over	5.4	77.5	76.7	78.8	80.8	80.3
Total	100.0	100.0	100.0	100.0	100.0	100.0

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[1] Eligibility ratio equals .6372 for 1980, .7237 for 1981, and .725 for 1982 and 1983.

TABLE 7.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT AND CREDIT AVAILABLE, WITH AND WITHOUT CARRYBACK, BY GROWTH CLASS

[Compustat data; dollars in millions]

Growth class	Number of firms	QRD	Base	QRD/Base −1 (percent)	Tentative credit (TENT)	Credit available		CRAVC/TENT (percent)	CRAVB/TENT (percent)	CRAVB QRD (percent)
						Current (CRAVC)	Carryback (CRAVB)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1981										
Over 100 percent	101	$490	$245	100.0	$61	$37	$60	60.1	97.4	12.2
0 to 100 percent	598	12,950	9,407	37.7	886	756	840	85.3	95.8	6.5
Less than 0	61	353	389	−9.2	0	0				0
Total	760	13,793	10,040	37.4	947	793	900	83.7	95.0	6.5
1982										
Over 100 percent	57	788	394	100.0	99	26	95	26.4	96.6	12.1
0 to 100 percent	563	25,444	19,943	27.6	1,375	899	1,300	65.4	94.6	5.1
Less than 0	123	2,091	2,338	−10.6	0	0	0			0
Total	743	28,323	22,675	24.9	1,474	925	1,396	62.8	94.7	4.9
1983										
Over 100 percent	37	303	151	100.0	38	26	32	69.9	83.4	10.4
0 to 100 percent	396	25,104	18,916	32.7	1,547	1,238	1,475	80.0	95.4	5.9
Less than 0	122	2,244	2,803	80.1	0	0	0			0
Total	555	27,651	21,870	26.4	1,585	1,264	1,507	79.8	95.1	5.5

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[1] Eligibility ratio equals .6372 for 1980, .7237 for 1981, and .725 for 1982 and 1983.

TABLE 8.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, CURRENT AND WITH CARRYBACK, BY GROWTH CLASS, AS PERCENT OF TOTAL

Growth class (1)	Percent of firms (2)	Qualified R&D (QRD) (3)	Base (4)	Tentative credit (TENT) (5)	Credit available: Current (GRAVC) (6)	Credit available: With carryback (CRAVB) (7)
1981						
Over 100 percent	13.3	3.6	2.4	6.5	4.7	6.7
0 to 100 percent	78.7	93.9	93.7	93.5	95.3	93.3
Less than 0	8.0	2.6	3.9	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
1982						
Over 100 percent	7.7	2.8	1.7	6.7	2.8	6.8
0 to 100 percent	75.8	89.8	88.0	93.3	97.2	93.2
Less than 0	16.6	7.4	10.3	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
1983						
Over 100 percent	6.7	1.1	0.7	2.4	2.1	2.1
0 to 100 percent	71.4	90.8	86.5	97.6	97.9	97.9
Less than 0	22.0	8.1	11.8	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0

[1] Eligibility ratio equals .6372 for 1980, .7237 for 1981, and .725 for 1982 and 1983.

TABLE 9.—QUALIFIED[1] R&D (QRD), BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, CURRENT AND WITH CARRYBACK, BY TAKEUP CLASS, COMPUSTAT DATA

[Dollars in millions]

Takeup class	Number of firms	QRD	Base	QRD/ Base −1 (percent)	Tentative credit (TENT)	Credit available		CRAVC/TENT (percent)	CRAVB/TENT (percent)	CRAVB/QRD (percent)
						Current (CRAVC)	With carryback (CRAVB)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1981										
Full	455	$8,955	$6,420	39.5	$6.36	$636	$635	100.0	99.9	7.1
Partial	15	735	524	40.3	53	31	51	59.1	97.5	7.0
Zero	129	1,664	1,244	33.8	107	0	69	.0	64.4	4.1
Total	599	11,354	8,818	38.7	796	667	756	83.0	95.0	6.7
1982										
Full	351	12,835	9,915	29.5	740	740	740	100.0	99.9	5.8
Partial	22	1,108	774	31.6	61	31	60	50.2	98.0	5.9
Zero	213	9,618	8,041	19.6	415	0	352	.0	84.8	3.7
Total	586	23,471	18,725	25.3	1,216	771	1,151	63.4	94.7	4.9
1983										
Full	292	16,757	12,850	30.4	993	993	990	100.0	99.7	5.9
Partial	21	1,395	931	49.8	116	63	105	54.2	90.7	7.5
Zero	132	5,379	4,843	11.1	214	0	164	.0	76.4	3.0
Total	445	23,530	18,624	26.3	1,323	1,056	1,258	79.8	95.1	5.3

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[1] Eligibility ratio equals 0.6372 for 1980, 0.7237 for 1981, and 0.725 for 1982 and 1983.

TABLE 10.—QUALIFIED [1] R&D, BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, CURRENT AND WITH CARRYBACK, BY TAKEUP CLASS AS PRECENT OF TOTAL

Takeup class	Percent of firms	Qualified R&D (QRD)	Base	Tentative credit (TENT)	Credit available: Current (CRAVC)	Credit available: With carryback (CRAVB)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1981						
Full	80.0	78.9	78.4	79.9	95.3	84.1
Partial	2.5	6.5	6.4	6.6	4.7	6.8
Zero	21.5	14.7	15.2	13.4	.0	9.1
Total	100.0	100.0	100.0	100.0	100.0	100.0
1982						
Full	59.9	54.7	52.9	60.9	96.0	64.2
Partial	3.8	4.3	4.1	5.0	4.0	5.2
Zero	36.3	41.0	42.9	34.1	.0	30.5
Total	100.0	100.0	100.0	100.0	100.0	100.0
1983						
Full	65.6	71.2	69.0	75.1	94.0	78.6
Partial	4.7	5.9	5.0	8.8	6.0	8.3
Zero	29.7	22.9	26.0	16.2	.0	13.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

[1] Eligibility ratio equals .6372 for 1980, .7237 for 1981, and .725 for 1982 and 1983.

TABLE 11.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, WITH AND WITHOUT CARRYBACK, COMPUSTAT DATA, BY INDUSTRY, 1981

[Dollars in millions; percent of total in parentheses]

Industry	Number of firms	QRD	Base	QRD/base −1 (percent)	Tentative credit (TENT)	Credit available		CRAVC/TENT (percent)	CRAVB TENT (percent)	CRAVB QRD (percent)
						Current (CRAVC)	With carryback (CRAVB)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Chemicals	90	$2,239	$1,612	38.9	$159	$139	$159	87.1	99.8	7.1
	(11.8)	(16.2)	(16.1)		(16.8)	(17.5)	(17.6)			
Metals	57	$263	$202	30.0	$15	$13	$15	86.5	95.5	5.6
	(7.5)	(1.9)	(2.0)		(1.6)	(1.6)	(1.7)			
Computers and other machines	80	$635	$457	39.1	$45	$38	$42	84.6	93.5	6.6
	(10.5)	(4.6)	(4.5)		(4.8)	(4.8)	(4.7)			
Communication equipment	129	$3,292	$2,361	39.5	$233	$204	$230	87.4	98.6	7.0
	(17.0)	(23.9)	(23.5)		(24.6)	(25.6)	(25.5)			
Other equipment	20	$1,862	$1,557	19.6	$76	$45	$46	58.8	59.9	2.5
	(2.6)	(13.5)	(15.5)		(8.1)	(5.7)	(5.1)			
Motor vehicles	21	$1,071	$763	40.4	$77	$52	$77	66.7	99.9	7.2
	(2.8)	(7.8)	(7.6)		(8.2)	(6.5)	(8.5)			
Aircraft	57	$817	$566	44.3	$63	$54	$62	86.1	99.4	7.6
	(7.5)	(5.9)	(5.6)		(6.6)	(6.8)	(6.9)			
Instruments	46	$561	$413	35.9	$39	$36	$38	93.0	99.1	6.8
	(6.1)	(4.1)	(4.1)		(4.1)	(4.5)	(4.2)			
Other	260	$3,052	$2,109	44.7	$239	$215	$234	90.2	97.8	7.7
	(34.2)	(22.1)	(21.0)		(25.2)	(27.0)	(25.9)			
Total	760	$13,793	$10,040	37.4	$947	$796	$903	84.1	95.4	6.5
	(100.0)	(100.0)	(100.0)		(100.0)	(100.0)	(100.0)			

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[1] Eligibility ratio equals 0.6372 for 1980 and 0.7237 for 1981.

TABLE 12.—QUALIFIED [1] R&D (QRD), BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, WITH AND WITHOUT CARRYBACK, COMPUSTAT DATA, BY INDUSTRY, 1982

[Dollars in millions; percent of total in parentheses]

Industry (1)	Number of firms (2)	QRD (3)	Base (4)	QRD/base—1 (percent) (5)	Tentative credit (TENT) (6)	Credit available: Current (GRAVC) (7)	Credit available: With carryback (CRAVB) (8)	CRAVC/TENT (percent) (9)	CRAVB/TENT (percent) (10)	CRAVB ORD (percent) (11)
Chemicals	90 (12.1)	$4,891 (17.3)	$3,710 (16.4)	32.0	$310 (21.0)	$160 (17.2)	$309 (22.0)	51.6	99.7	6.3
Metals	52 (7.0)	$441 (1.6)	$414 (1.8)	6.5	$11 (0.8)	6 (0.6)	11 (0.8)	50.4	100.0	2.6
Computers and other machines	78 (10.5)	$1,248 (4.4)	$1,045 4.6	19.5	$53 (3.6)	$29 (3.1)	$52	53.9	97.4	4.2
Communication	129 (17.4)	$7,098 (25.1)	$5,444 (24.0)	30.4	$414 (28.1)	$294 (31.6)	$409 (29.2)	71.1	98.7	5.8
Other equipment	20 (2.7)	$3,671 (13.0)	$3,354 (14.8)	9.5	$89 (6.0)	$28 (3.0)	$44 (3.1)	31.5	48.9	1.2
Motor vehicles	21 (2.8)	$2,203 (7.8)	$1,755 (7.7)	25.5	$124 (8.4)	$70 (7.5)	$121 (8.6)	56.6	97.4	5.5
Aircraft	57 (7.7)	$1,682 (5.9)	$1,327 (5.9)	26.7	$91 (6.2)	$50 (5.4)	$88 (6.2)	55.4	97.1	5.2
Instruments	46 (6.2)	$1,225 (4.3)	$944 (4.2)	29.8	$71 (4.8)	$46 (4.9)	$69 (4.9)	64.9	97.1	5.6
Other	250 (33.6)	$5,856 (20.7)	$4,683 (20.7)	25.1	$311 (21.1)	$247 (26.6)	$300 (21.4)	79.5	96.5	5.1
Total	743 (100.0)	$28,327 (100.0)	$22,675 (100.0)	24.9	$1,474 (100.0)	$900 (100.0)	$1.402 (100.0)	63.1	94.5	4.9

[1] Eligibility ratio equals 0.6372 for 1980, 0.7237 for 1981, and 0.725 for 1982.

TABLE 13.—QUALIFIED[1] R&D (QRD), BASE, TENTATIVE CREDIT, AND CREDIT AVAILABLE, WITH AND WITHOUT CARRYBACK, COMPUSTAT DATA, BY INDUSTRY, 1983

[Dollars in millions; percent of total in parentheses]

Industry	Number of firms	QRD	Base	QRD/base − 1 (percent)	Tentative credit (TENT)	Credit available		CRAVC/TENT (percent)	CRAVB/TENT (percent)	CRAVB/QRD (percent)
						Current (CRAVC)	With carryback (CRAVB)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Chemicals	81	$5,390	$4,067	32.5	$338	$201	$377	59.6	99.9	6.3
	(14.6)	(19.5)	(18.6)		(24.9)	(16.0)	(24.9)			
Metals	37	$366	$345	5.9	$10	$8	$10	85.3	99.4	2.7
	(6.7)	(1.3)	(1.6)		(0.6)	(0.6)	(0.7)			
Computers and other machines	62	$1,059	$994	6.5	$26	$15	$24	57.6	91.8	2.3
	(11.2)	(3.8)	(4.5)		(1.6)	(1.2)	(1.6)			
Communication equipment	99	$7,015	$5,006	40.1	$506	$427	$494	84.4	97.6	7.0
	(17.8)	(25.4)	(22.9)		(31.9)	(33.9)	(32.6)			
Other equipment	17	$3,638	$3,228	12.7	$125	$89	$89	71.0	71.0	2.4
	(3.1)	13.2)	14.8)		(7.9)	(7.1)	(5.9)			
Motor vehicles	19	$2,041	$1,801	12.9	$119	$97	$109	81.3	91.1	5.3
	(3.4)	(7.4)	(8.3)		(7.5)	(7.7)	(7.2)			
Aircraft	39	$1,605	$1,325	21.1	$74	$66	$74	88.7	99.7	4.6
	(7.0)	(5.8)	(6.1)		(4.7)	(5.2)	(4.9)			
Instruments	35	$1.291	$951	35.8	$86	$79	$82	92.1	95.9	6.4
	(6.3)	(4.7)	(4.3)		(5.4)	(5.2)	(4.9)			
Other	166	$5,246	$4,146	26.5	$301	$276	$298	91.9	98.9	5.7
	(29.9)	(19.0)	(19.0)		(19.0)	(21.9)	(19.7)			
Total	555	$27,651	$21,870	26.4	$1,585	$1,259	$1,516	79.4	95.6	5.5
	(100.0)	(100.0)	(100.0)		(100.0)	(100.0)	(100.0)			

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[1] Eligibility ratio equal 0.6372 for 1980, 0.7237 for 1981, and 0.725 for 1982.

TABLE 14.—PROJECTIONS OF QUALIFIED [1] R&D GROWTH RATES AND TENTATIVE CREDIT FROM McGRAW-HILL SURVEY, 1984–87

[Dollars in millions]

(1)	Qualified R&D (2)	Growth rate (percent) (3)	Tentative credit (4)
Year:			
1984	$34,801	12.5	$1,702
1985	37,575	7.97	1,544
1986	40,846	8.71	1,539
1987	44,355	8.59	1,618

[1] Eligibility ratios are taken as 0.7237 for 1981 and 0.725 for all years from 1982 to 1987.

TABLE 15.—PROJECTIONS OF QUALIFIED [1] R&D (QRD) AND TENTATIVE CREDIT, BY INDUSTRY, FROM McGRAW-HILL SURVEY, 1984 TO 1987

Industry	Qualified R&D				Tentative credit			
	1984	1985	1986	1987	1984	1985	1986	1987
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Chemicals	5,793	6,474	6,970	7,507	283	249	245	255
Metals	507	548	613	673	13	18	26	27
Computers and other machinery	1,300	1,443	1,606	1,791	28	50	74	85
Communication equipment	9,805	11,097	12,707	14,415	649	666	709	785
Other equipment	4,074	4,139	4,218	4,312	93	65	40	42
Motor vehicles	2,238	2,360	2,481	2,608	75	50	58	61
Aircraft	1,926	2,077	2,249	2,448	71	70	80	90
Instruments	1,602	1,802	2,082	2,287	92	97	106	119
Other	7,376	7,634	7,975	8,314	397	278	204	154

[1] Eligibility ratios taken as 0.7273 for 1981 and 0.725 for all years from 1982 to 1987.

THE NEW INCREMENTAL TAX CREDIT FOR R&D: INCENTIVE OR DISINCENTIVE? 16TH CIRET CONFERENCE, SEPTEMBER 21 TO 24, 1983, WASHINGTON, DC

(By Robert Eisner, Steven H. Albert, and Martin A. Sullivan*)

PREFACE

The following paper is a preliminary study of a current American experiment in tax incentives for R&D expenditures. It essays initially an analytic, a priori examination of the provisions of a new incremental tax credit for R&D, noting both the variety of tax benefits and implicit incentives and disincentives. It then utilizes three main bodies of data: tabulations by industry from the Office of Tax Analysis of the U.S. Department of the Treasury, Securities and Exchange Commission company reports as compiled on Standard and Poor's Compustat tapes, and individual responses from both the R&D section of regular McGraw-Hill spring surveys and a special "supplementary research and development survey" bearing specifically on the new incremental tax credit. These bodies of data have been employed in large part to estimate amounts and distribution of the tax credit.

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TAX INCENTIVES AND R&D EXPENDITURES

Company-funded research and development expenditures in the United States showed rapid real growth in the 1960's, slipped in the first half of the next decade and rebounded thereafter. Finally increasing at almost nine percent in 1980, despite a mild recession, they reached a level of $30.5 billion, or 1.16 percent of GNP. In 1981 the tax laws were amended to offer various incentives to further that growth.

The major new provision was a 25 percent tax credit for increases in certain types of R&D expenditures. The credit began with expenditures in the latter half of 1981 and was scheduled to expire at the end of 1985.

In the spring of 1982, with the support of the National Science Foundation, we undertook an ongoing analysis of this experiment in process. Our objectives have been to estimate tax incidence and effect on R&D expenditures. Initial reports are to be found in Eisner (1982) and Collins (1983). Now, after the credit has been in effect some two years, we offer further but still preliminary analysis.

We have thus far been able to develop and use three main bodies of data. These came first from the regular McGraw-Hill spring capital expenditure surveys of 1981, 1982 and 1983, which include a section on R&D expenditures and expenditure anticipations. In 1982, on our behest, McGraw-Hill added several special questions dealing with the new tax credit. In 1983 they undertook a special "supplementary research and development survey," for which we drafted the questionnaire.

Our second primary source of data has been Compustat series for some 800 firms from 1973 to 1982, first taken for recent years from Business Week reports of July 5, 1982 and June 20, 1983. Finally, we have secured from the Office of Tax Analysis of the U.S. Department of the Treasury a special run by three-digit and four-digit industry of information from tax form 6765, used by firms in reporting their R&D tax credit for 1981. Both the Business Week-Compustat and McGraw-Hill data were for individual companies, in the latter case by code number to preserve anonymity of survey responses.

Our analysis will combine an analytic examination of the incremental R&D tax credit and empirical exploration of the survey and relevant financial and tax data.

I. ANALYTICAL FRAMEWORK

1. Statutory and effective credits

Under the Economic Recovery Tax Act of 1981, businesses are offered a credit for increasing qualified research activities. These generally relate to company-financed current expenses, including wages, supplies, rental or lease costs (but not depreciation) and 65 percent of contract research. R&D conducted outside of the United States, financed by government or in the social sciences is excluded.

The credit is incremental in character, amounting to 25 percent of the excess of current R&D expenditures over a base which is company-specific and shifts in time. For 1981 qualified expenditures are limited to those after June 30 and the base consists of half of qualified expenditures of all of the year 1980. For 1982, the base consists of the arithmetic mean of qualified expenditures of all of 1980 and 1981. For 1983, 1984 and 1985, the base for each year is the mean of qualified expenditures for the three preceding years. The credit is currently scheduled to expire at the end of 1985, although the Treasury has now joined supporters of its extension beyond that year.

The definition of the base is modified, however, by the requirement that it may never be less than 50 percent of current qualified expenditures. Thus, as R&D exceeds 200 percent of its normally defined base, the redefined base is increased 50 cents for each additional dollar of R&D expenditures, reducing the marginal incremental tax credit from 25 percent to 12.5 percent for such expenditures.

Since the credit is against business income tax liabilities, it is not applicable to current taxes in the very considerable number of cases where firms do not have current tax obligations. Unused credits can be carried back three years and carried forward 15 years.

As of this date, final regulations for implementing the credit have not been promulgated. More than usual latitude has perhaps hence been available to taxpayers in calculation of the credit, particularly in the categorization of "qualified" R&D expenditures.

Systematic analysis of the terms for this credit for increasing research activities suggests a number of significant effects, not all perhaps anticipated by framers of the legislation. First, rather obviously, since qualified expenditures are all defined in nominal terms, in periods of inflation firms may enjoy substantial tax reductions with no real increase in R&D expenditures, and even with some substantial decline. Second, since the credit applies to increments in "qualified" expenditures, the amount of the credit depends both on the proportion of R&D expenditures qualified in the current year and the proportions qualified in base years. Shifts from the base year to the current year in proportions of R&D expenditures deemed qualified can have major effects upon the magnitude of tax credit, with no change in total R&D expenditures.

But most important, the fact that increases in current R&D expenditures over what they would have been without the credit may or may not increase the current credit and may or may not decrease future credits offers a varied menu of consequences, some fairly bizarre. For among the possibilities are the following: (1a) qualified current R&D expenditures will not be increased to an amount in excess of the base and therefore the current credit will be identically equal to zero; (1b) qualified current expenditures will be more than twice base-period expenditures so that each additional dollar of current qualified expenditures will raise the redefined base by 50 cents and limit the marginal credit to 12.5 percent of each additional dollar of expenditures; (1c) qualified expenditures will be within the range of 100 percent and 200 percent of the base, so that the full 25 percent current credit will be enjoyed; (2a) qualified expenditures in one or more of the succeeding three years will be less than 100 percent of their base; (2b) qualifying expenditures in one or more of the succeeding three years will be more than 200 percent of their base; (2c) qualified expenditures in each of the succeeding three years will be between 100 and 200 percent of their base; (3a) a lack of tax liabilities in the current and three preceding years will prevent current use of the credit and induce a carry-forward; (3b) lack of tax liabilities in future years will cause deferral of the effects of current R&D expenditures on future credits.

The various combinations of possibilities 1a to 1c, 2a to 2c and 3a or 3b are further complicated by uncertainties for each firm as to the state of the world in which it will fit. A firm contemplating an increase in qualified R&D expenditures may find it difficult to evaluate the likely impact on future bases and credits.

Take, for example, an informed firm anticipating qualified expenditures above base but less than twice as much as base in each of the years 1981 to 1984. In considering whether to increase its R&D budget in 1981 it would have had to reckon that each additional dollar of R&D spending in the latter half of that year would generate not only a 25 cent reduction in tax liabilities for that year but also a 12.5 cent consequent increase in tax liabilities in 1982 and 8.33 cent increases in tax liabilities in each of the years 1982 and 1983. (The 1982 base, equal to the mean of 1980 and 1981 qualified expenditures, would be raised by 50 cents, and the 1982 and 1983 bases, each of which is the mean of qualified expenditures over the three previous years, would each be raised by 33.33 cents.) The 25 cent tax saving on each additional dollar of qualified R&D expenditures in 1981 would hence generate increased taxes of 29.2 cents over the years 1982, 1983 and 1984.

Taking account of the consequent increase in future tax liabilities, the effective rate of tax credit for 1981 expenditures,[1] at a discount rate of 10 percent, is then actually 0.5 percent, a small fraction of the 25 percent statutory rate. Indeed, at a rate of discount of 8.8 percent, the effective rate of the tax credit becomes zero and, at rates of discount below 8.8 percent, the effective rate of tax credit is in fact negative. In this latter instance the incremental tax credit offers short-term, current gain but penalizes firms over a longer-run three-year period for R&D expenditures in 1981. A firm with a rate of discount less than 8.8 percent would be better advised to reduce its current qualified R&D expenditures, accepting the resultant reduction in current R&D tax credit, in order to reduce its base and hence raise its tax credit for future years.

Consequences for years after 1981 for firms with current and anticipated tax liabilities whose growth in qualified research over base falls in the zero to 100 percent range are not quite as extreme. Again, however, the effective rate of tax credit with a ten percent rate of discount is relatively low, 4.3 percent rather than the current credit of 25 percent.

There are other combinations, however, in which the effective rate of tax credit may be negative, and sharply so. Again assuming a 10 percent rate of discount and tax liabilities in all relevant years, a firm with current qualified expenditures more than 100 percent above its base period amount, but with expected future increases over base in the zero to 100 percent range in each of the three following years, will find its effective rate of tax credit is −8.2 percent. For each additional dollar of current qualified expenditures will reduce the firm's current taxes by 12.5 cents while future taxes are raised by 8.33 cents in each of the three following years, for a total increase of 25 cents. The present value of this future tax increase is 20.7 cents, as against a 12.5 cents current tax saving for each increase of one dollar in qualified current R&D expenditures.

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[1] In all instances, it should be recalled, effective rates relate to marginal and not total R&D expenditures. The distinction is illustrated in "Appendix A. Short-term and Long-term Effects of R&D Changes on Incremental Tax Credit."

An even more extreme situation arises when an increase in current R&D expenditures will still leave them below their base period amount. Such an increase in qualifying current expenditures generates no current tax saving but may reduce future credits by increasing bases for future years. In the event that future years' qualifying expenditures would be above their bases by more than zero but less than 100 percent, losses in future credit would total 25 cents for each dollar increase in current expenditures. At a rate of discount of 10 percent, the effective credit is −20.7 percent. Far from decreasing taxes by 25 cents, each additional dollar in qualifying current R&D expenditures would thus raise the present value of tax liabilities by 20.7 cents. In these instances of negative effective tax credits, the response to the incremental R&D tax credit by rational, informed firms, cost of adjustment and intertemporal complementarity considerations aside, would be not to increase but rather to reduce current qualified R&D expenditures.

The necessity of carry-forward in years where there are no tax liabilities or insufficient tax liabilities in both the current and three preceding years also operates to reduce the effective rate of tax credit. For the "normal" case where there are and will be taxes to be offset and where qualified expenditures are growing by between zero and 100 percent of their base, the effective rate of tax credit on marginal qualified R&D expenditures is positive. This is so, even though, other things being equal, future tax credits are reduced dollar for dollar for current increases. Because of the discount factor, current reductions in taxes have a greater present value than future increases.

To the extent that realization of a current tax credit must be deferred because of the lack of current tax liabilities, however, this discount advantage is lost. Increases in qualified current R&D expenditures lower future credits and postpone additional current credits until the future. For example, a firm contemplating $12 million of additional expenditures in 1982, foreseeing no tax liabilities for 1982, 1983 and 1984 but anticipating tax liabilities in 1985, would derive no tax advantage from the incremental credit. The increased expenditures of $12 million in 1982 would generate a $3 million tax credit which would be carried forward to 1985. It would also reduce by $1 million the tax credits for 1983 and 1984, to be carried forward to 1985, and also reduce by $1 million the tax credit for 1985 itself. The net effect would thus be zero, a carry-forward of $3 million of tax credits from 1982 to 1985 minus a reduction of $3 million in tax credits for 1985 directly and carried forward from 1983 and 1984.

The one situation in which the credit would be most effective is that in which a firm is spending more than base in the current year but anticipates being below base in the three subsequent years. The effective marginal rates of tax credit, if there are current taxes to be offset, is then equal to the statutory rates, 25 percent, or 12.5 percent for expenditures more than 100 percent above base.

All of the analysis thus far has been based on the assumption that the incremental tax credit will be extended indefinitely beyond its current legal date of termination. If in fact the credit is expected to die at the end of 1985, increases in qualified R&D expenditures in 1983 can reduce anticipated future credits only in 1984 and 1985. Increases in expenditures in 1984 can reduce anticipated future credits only in 1985. And increases in expenditures in 1985 will have no impact on future credits.

Thus, again assuming a 10 percent rate of discount, the effective rate of tax credit in 1983 for firms which are and expect to be in the "normal" range of growth over base (positive but less than 100 percent) will equal $.25-.0833\,(1.1^{-1}+1.1^{-2})$, or 10.54 percent. For 1984 the effective rate of tax credit will equal $.25-.083\,(1.1)^{-1}$, or 17.42 percent\ And for 1985 the effective rate of credit will finally take on its full statutory rate of 25 percent.

Analogous calculations would be in order for firms in other categories. Thus in 1983 a firm with qualified expenditures more than 100 percent above mean qualified expenditures of the three previous years, but expecting to be in the normal range in 1984 and 1985, would find its effective rate of credit, with a 10 percent rate of discount, equals $.125 - .0833\,({}^{-1} + 1.1^{-2})$, or −1.196 percent. This compares with the even more negative rate of −8.22 percent, noted above, on the assumption that the credit will not terminate at the end of 1985.

In 1984 a firm in the 12.5 percent current rate category but expected to be in the normal range in 1985, would find its effective rate of credit positive, amounting to $.125-.0833\ (1.1)^{-1}$, or 4.92 percent. And in 1985 the effective rate would be 12.5 percent. We may note, finally, that if the credit is in fact expected to terminate at the end of 1985, the incentive to reduce expenditures for firms that would in any event be below base would become progressively less in the final years. It would be completely gone in 1985.

2. Magnitudes of company tax savings and Treasury revenue losses

Treasury revenue losses from the R&D credit are difficult to predict, however, because of its incremental character. (Treasury losses due to the investment tax credit, dependent on the flow of investment in eligible equipment, are relatively easier to forecast since changes in spending are relatively more volatile than their levels.) Further, since the R&D credit is tied to expenditures in nominal terms, the rate of inflation has a major impact. With changes in rates of inflation generally more difficult to predict than changes in real growth, the problem of anticipating revenue losses from the R&D tax credit is further compounded. And most importantly, changes in the ratio of qualified or eligible expenditures to total R&D spending, what we shall refer to as eligibility ratios, will have what may appear to be an overwhelming impact on the amounts of credit claimed.

Certain things can be predicted, however, in terms of the definition of the R&D credit. First, since for 1981 it applies only to qualified expenditures after June 30, while for the years 1982 through 1985 it applies to all qualified expenditures, we might expect an approximate doubling of the credit from 1981 to 1982. This effect is immediately modified, however, by the shifting nature of the base. For 1981 the base, aside from the 100 percent growth limitation, is equal to half of qualified 1980 expenditures. Hence, the base is lagged 1.25 years, from the second half of 1981 to all of 1980. For 1982, though, the base, calculated as a mean of 1980 and 1981 qualified expenditures, is lagged on average 1.5 years, while for 1983, 1984 and 1985 the average lag of the base is two years. For generally increasing rates of qualified expenditures, average lag of the base tends to increase the increment in expenditures subject to the credit.

Thus, if qualified R&D expenditures were growing at a constant annual rate of 10 percent and the credit for 1981 were calculated on the difference between half of 1981 expenditures and half of 1980 expenditures the credit as a fraction of 1980 qualifying expenditures would be $.25\ (1.1-1)/2=0.0125$. Recognizing the 1.25 year lag in the base for 1981, however, it is more appropriate to assume that R&D expenditures were growing throughout 1980 and 1981. Thus a 10 percent per annum growth would imply a half-year growth in expenditures of $(1.1)^{.5}-1$, or 4.88 percent. Again normalizing so that total expenditures in 1980 are 1.0 and in 1981 are 1.1, we have a sequence for the four successive half-years of 0.488, 0.512, 0.537, 0.563. For each dollar of 1980 expenditures the credit for 1981 is then $.25(0.5631026-0.5)=0.057757$. Thus, for firms whose R&D is growing at 10 percent per year, the effect of calculating the credit on the difference between R&D expenditures in the latter half of 1981 and half of all of 1980 expenditures rather than on half the difference between the totals for both years is to raise our estimate of the credit, from 0.0125 to 0.0158 per dollar of 1980 R&D, or some 26.2 percent.

For 1982, the credit would be $.25\ [1.21-.5\ (1+1.1)]=4.0$. Had there been no increase in the average lag of the base, with a 10 percent growth in R&D expenditures, the credit would have increased from 0.0158 to 0.0338, or 115 percent. With the increase in the lag of the base, however, the increase in the credit, from 0.0158 to 0.04, is 154 percent.

A similar increase in the amount of the credit due to the increasing lag of the base then takes place in 1983. For this year the credit will equal $.25[1.1^3-1/3\ (1+1.1+1.1^2)]=.0569167$, a 42.3 percent increase in the credit over that of the previous year where, without lengthening of the base, the credit would have increased by only 10 percent. For the years 1983, 1984 and 1985 the average lag of the base will have reached its equilibrium value of two years and there will be no further increases in the credit from this factor.

It is important to recognize that the increasing length of the base will tent to increase the credit more, for any given rates of real growth, the greater is the inflation factor in R&D spending. Even with no real growth and a constant rate of inflation, the R&D tax credit would grow from 1981 to 1982 and from 1982 to 1983 along the lines that we have indicated.

Two further factors affecting the trend of revenue loss or company tax saving may be cited. First, there is a transitional factor. The first year tax credit, in 1981, may tend to be unduly high where firms, perhaps oblivious of future losses of the credit, may be inclined to classify large portions or 1981 R&D expenditures as qualified and as occuring after June 30. There is no incentive to set 1980 qualifying expenditures high as they contribute only to raising the base and therefore lowering the tax credit for future years. There may hence be a substantial, one-time increase in the eligibility ratio from 1980 to 1981. If the eligibility ratio has been unduly inflated for all of 1981, there may then even be a regression or decline in 1982.

Second, small swings in the eligibility ratio can have a major impact on the amount of the tax credit. A relatively modest shift in the eligibility ratio, from 65 percent to 70 percent from 1980 to 1981, for example, would increase by some 59 percent the R&D credit resulting from a 15 percent growth over base.

Finally, to the extent that R&D spending follows the business cycle, the credit will tend to be pro-cyclical, reducing taxes in time of boom and inflation and increasing them in time of recession. Downturns in the rate of growth of R&D expenditures and, a fortiori, actual declines, not only reduce the tax credit and hence increase taxes in time of recession. By lowering the base they tend, as a corollary, to increase tax credits and thus lower taxes in future years of boom. Further, since the credit is not refundable but is merely an offset to tax liabilities, its effect in increasing firm net income will be all the less in recessions when, because of low profits, there may be no tax liabilities. The consequent carry-forward of the credits will increase net income all the more at the peak of a business cycle when there are tax liabilities to be offset.[2]

3. Summary

The incremental tax credit for qualified R&D expenditures has a number of perverse and possibly unanticipated effects. For some firms, particularly in 1981, but to a considerable extent in other years as well, the marginal impact of the credit on qualified expenditures is negative. They find themselves better off by lowering 1981 expenditures in the interest of claiming a credit or larger credit in future years. In any event, the effective value of the credit, that is, the reduction in cost of additional current R&D expenditures resulting from the current credit net of the present value of consequent losses of future credits, is likely to be very low. Common values are in the order of zero to 3 or 4 percent, depending upon rates of discount, rather than the 25 percent statutory rate.

If the credit is expected to expire at the end of 1985, however, the effective rate of credit rises in 1983, 1984 and 1985, reaching its statutory level in that last year. As a corollary, as the credit termination date is approached, firms below base will lose their incentive to cut expenditures in order to claim credits in the future.

The definition of the company-specific base with an increasing lag over the first two years contributes to sharply rising values of the credit from 1981 to 1983. If rates of inflation, rates of growth of real R&D expenditures and eligibility ratios were stable, the growth of the credit itself would be stable over the last years of the credit under current law.

Both inflation and cyclical effects are substantial. Higher rates of inflation swell the tax credit with no changes or even declines in the real rate of growth of R&D. The Treasury may lose substantial amounts of tax revenues because of increases in nominal R&D expenditures while real expenditures are declining. The amount of the credit will not only tend to be considerably less in periods of recession but the low base set in recessions will raise future credits, in time of subsequent booms, all the more.

II. OFFICE OF TAX ANALYSIS DATA

The preliminary tabulation of R&D tax credit data made available to us by the Office of Tax Analysis is based on a sample of 2,678 1981 returns representing 11,029 business taxpayers. These were blown up and aggregated in 97 industries. A number of returns, including those of some large firms, had not been received. The OTA estimates that the data thus far available account for some 80 percent of 1981 R&D expenditures.

Since the data were from form 6765 used to file reports of eligibility for the tax credit, they are essentially limited to firms who claimed qualified R&D expenditures after June 30, 1981 exceeding half of their qualified expenditures in all of the year 1980. Thus, in effect, the OTA data are truncated at zero with regard to rates of growth of qualified R&D.

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[2] A number of the relationships discussed above are presented more rigorously in "Appendix B. Mathematical Exposition."

The tabulations indicate qualified R&D expenditures of $6,448 million for the population represented by this sample, as shown in Table 2.1. This entailed an increase of no less than 42.7 percent over the $4,519 million base from 1980. The tentative credit was then $408.4 million but lack of tax liability against which to offset it reduced this total by $176.6 million—some 43.2 percent—so that the total credit claimed currently in the population represented by the sample comes to $231.8 million. The Office of Tax Analysis, apparently relying upon additional information for firms not included in the sample, estimates from these data that the total credit "claimed" in 1981—presumably the "tentative credit" in view of the sample data—was some $600 million.[3]

Extensive cross section analysis of the data for these 97 industries indicated little relation between growth in qualified expenditures and the ratio to assets of the credit actually claimed, as indicated in equations (2.1) and (2.3). There was some evidence of a negative relation between the growth in R&D and the ratio to assets of credit earned but not claimed because of lack of tax liability, as shown in equations (2.2) and (2.3).

(2.1) $$\text{QR\&DG} = \underset{(0.116)}{0.972} - \underset{(0.000182)}{0.000035}\ \text{CRARAT}$$

$$\hat{R}^2 = -0.010 \qquad n = 97$$

(2.2) $$\text{QR\&DG} = \underset{(0.119)}{1.070} - \underset{(0.000384)}{0.000585}\ \text{TLARAT}$$

$$\hat{R}^2 = 0.014 \qquad n = 97$$

(2.3) $$\text{QR\&DG} = \underset{(0.117)}{1.020} - \underset{(0.000175)}{0.000304}\ \text{CRARAT}$$

$$+ \underset{(0.000465)}{0.002345}\ \text{LLARAT} - \underset{(0.000378}{0.001318}\ \text{TLARAT}$$

$$\hat{R}^2 = 0.209 \qquad n = 97$$

QR&DG = Qualified R&D growth

CRARAT = CRDCCL ÷ ASSETS

TLARAT = (TNTCRD - CRDCCL) ÷ ASSETS

LLARAT = (CROLIM - TNTCRD) ÷ ASSETS

where CRDCCL = Credit currently claimed

TNTCRD = Tentative credit (without regard to existence of taxes to be offset)

CROLIM = .25 (QUAL R&D - BASE), thus the credit calculated from industry aggregates as if no firms had qualified R&D expenditures either below or more than twice their base

ASSETS = "total assets," financial and non-financial.

This last result is subject to several possible interpretations. It may, of course, represent a quite spurious correlation between industries if, for one reason or another, more firms without tax liabilities are in industries with relatively greater R&D intensity.

The negative relation may, however, stem from a greater reluctance to raise R&D expenditures on the part of firms with lower profits. Or it may reflect the fact that firms unable currently to enjoy the tax credit increase their R&D expenditures less than firms that are able to realize it.

The significantly positive coefficient of LLARAT in (2.3) would seem to reflect the considerable number of firms in the OTA sample reporting qualified R&D more than twice their base and hence running into the 50 percent base limitation.

III. COMPUSTAT DATA

We took initially the Compustat R&D data as reported in Business Week in 1982 and 1983. Putting together data in the two reports, we had the R&D expenditures of 690 companies for 1980, 1981 and 1982. The 1980 sum of $27,355 million in R&D expenditures for these firms was nearly 90 percent of the NSF estimate of nationwide company-financed R&D in that year.

The rate of growth of R&D in this sample, which in view of its coverage leaves little room for bias, was 14.9 percent from 1980 to 1981. Truncating the sample to include only firms with 1981 R&D above 1980 R&D and projecting second-half 1981 R&D in accordance with (3.1), below, indicates a 1981 rate of growth over base of 21 percent in the Compustat data, far less than the 43 percent growth of qualified expenditures over base in the OTA tabulation. The rate of growth of R&D slackened sharply to 11.3 percent from 1981 to 1982. This reduction in growth would suggest that, if the eligibility ratios were constant over these years, the increase in tentative credit from 1981 to 1982 would be considerably less than what would have been predicted on the assumption of constant growth rates. Had the 1980–81 R&D growth rate of 14.9 percent been maintained, the tentative credit, on the assumption of a constant eligibility ratio, would have grown some 160 percent. But as shown in Tables 3.1 and 3.2, under that assumption of constant eligibility ratio, the actual increase in tentative credit which is indicated is in the order of 122 percent.

Estimation of tax credits from annual R&D data is complicated for 1981 by the restriction of qualified expenditures to those after June 30. We have imputed second-half-of-year figures by assuming steady growth over the year 1981 equal to the annual growth of 1981 over 1980. Thus, 1981 R&D expenditures after June 30 are calculated as: (3.1) $\mathrm{RD81\text{-}II} = \mathrm{RD81}/(\mathrm{RD80}/\mathrm{RD81})^{.5} + 1]$, where RD81 and RD80 are the annual R&D expenditures for 1981 and 1980, respectively.

The eligibility ratio of .6329144 used in calculating tentative credits in Tables 3.1 and 3.2, and elsewhere in this section, was derived, as explained in Eisner (1982), p. 13, by assuming that the proportions of R&D cost not eligible in computation of the credit correspond to "Other R&D costs" for 1979 as listed in NSF (1981, Table B–51, p. 43), "Distribution of R&D Costs by Industry." We have maintained the same eligibility ratio in a number of our calculations in this paper, in the interest of comparability with the earlier analysis and on the basis of data from our McGraw-Hill special supplementary R&D survey, discussed below.

Tables 3.1 and 3.2 make clear that with constant eligibility ratios the variation among industries in growth of tentative credit for 1981 to 1982 is substantial. In computers (listed under "Info. Proc."), where the year-over-year rate of growth of R&D expenditures actually increased from 15.3 percent to 22.7 percent, the indicated tentative credit grew by 244.9 percent. At the other end of the scale were containers, where with a decline in the rate of growth of R&D for the entire industry from 5.8 percent to −16.9 percent, the percent change in the tentative credit was −17.1 percent. In fuel, where the year-over-year rate of growth in R&D expenditures declined from 31.7 percent to 6.2 percent, the growth in the tentative credit was only 19.7 percent and in automotive parts and equipment, where the rate of growth in R&D declined from 18.7 percent to 4.6 percent, the rate of growth in the credit was only 25.2 percent.

The Business Week reports of company R&D expenditures were not accompanied by information on taxes currently payable. This information is of course available on the original Compustat tape. Utilizing a set of 592 companies for which information on R&D expenditures for the years 1980, 1981 and 1982, and on taxes for the years 1981 and 1982 was to be found on the tape, we still had a very large, if somewhat smaller coverage of R&D, as indicated in Table 3.3. Rates of growth were just about the same as in the Business Week reports, now 14.8 percent from 1980 to 1981 and 11.4 percent for 1981 to 1982. We may also note that R&D expenditures are highly concentrated. The great bulk, over 76 percent in the sample and perhaps almost as large a percentage in the population as a whole, were financed by firms whose 1982 R&D expenditures were $100 million or more. This relates to only 66 out of the total of 592 firms in our Compustat sample.

Coming as close as the data permitted to the definition in the law and in our mathematical appendix, we calculated the credit currently claimed as equal to the tentative credit where the federal income tax payable was positive and zero where the federal income tax was zero or negative. On this basis, as shown in Table 3.4, the nationwide tentative credit of $465 million in 1981 is reduced to a currently claimed credit of $402 million. This reduction of 14 percent, we must note, is far less than the 43 percent reduction found in the OTA data. That difference offers a considerable puzzle. It is not clear how much it may relate to errors in reporting on the forms or in the preliminary and incompletely checked OTA file given to us or how much the discrepancy may be due to our inability to take account in the Compustat data of other tax credits or adjustments which may have precluded current claims of a new incremental R&D credit. The difference may also relate to inclusion in the OTA sample of smaller firms or others without information on the Compustat tape.

What is all the more startling, however, is the much greater falloff in credit currently claimed indicated in our Compustat data for 1982. The combination of business recession and increasing tax deductions from the accelerated cost recovery system apparently brought a considerably larger number of firms into the no-tax category. With the ratio of the credit currently claimed to the tentative credit falling to 65.2 percent in 1982, the credit currently claimed rose only from $402 million to $682 million.

The percent increases in the tentative credit were clearly positively associated with the amount of 1982 R&D spending, as shown in Table 3.5, but this may well reflect in part the consequence of our categorization on the basis of 1982 R&D. To the extent that individual firm R&D spending has random variation from year to year, those firms with more spending in any one year would on average have higher rates of growth than those firms having low spending in that year.

Two classes of firms would not receive R&D tax credits: those where R&D does not exceed base and those where R&D exceeds base but where no federal income taxes are payable. Undertaking that division for 1981, we note in Table 3.6 that 112 of the 592 firms have R&D below base. This proportion was largest, however, among firms doing the least R&D (15 out of 32 for firms of 1982 R&D less than $1 million and only 4 out of 66 for firms spending $100 million or more). Hence firms with R&D below base accounted for only 6.1 percent of R&D expenditures by the 592 firms in the sample. Another 83 firms, accounting for 13.1 percent of R&D expenditures, did have R&D greater than base but had no federal income taxes which the credit might offset.

Thus, in 1981, 80.7 percent of R&D expenditures in this 592-firm set were undertaken by companies which presumably were receiving the R&D tax credit. The proportions descended progressively for the different amount-of-R&D categories, from 83.3 percent for those spending $100 million or more in 1982 down to 43.7 percent for those in the under $1 million category.

Similar data for 1982, presented in Table 3.7, indicate that only 52.7 percent of qalified R&D expenditures were undertaken by firms receiving the credit. For 15.3 percent of R&D expenditures were made by firms whose qualified R&D did not exceed their base. And no less than 32.1 percent, or $6,480 out of $20,215 million, occurred in firms where R&D exceeded the base but there was no federal income tax payable. The proportion of total R&D taking place in firms which received a credit was somewhat smaller still, 45.9 percent, in the set of 92 firms with R&D expenditures under $1 million.

Differences among industries were sharp. We note that 98.7 percent of R&D expenditures of $959 million in the drug industry were made by firms that should have been able to claim the credit. But for motor vehicles and parts, in which total R&D expenditures came to $3,147 million, only 9.6 percent (or $301 million) were made by the 7 out of 17 firms claiming a current credit.

In Tables 3.8 and 3.9, both again calculated on the assumption of the constant elibibility ratio (of 0.6329144) for all firms in 1980, 1981 and 1982, we may note readily the substantial variation across industries in both the tentative credit and the credit currently claimed. For the compilation of 592 firms the tentative credit in 1981 was 4.05 percent while the credit currently claimed was 3.50 percent of qualified R&D. For 1982, as shown in Table 3.11, calculated from Table 3.10, those ratios were respectively 4.24 percent and 2.76 percent. The ratio of credit currently claimed to qualified R&D in 1982 varied among industries from 5.04 percent for other manufacturing, 4.83 percent for paper, 4.82 percent for drugs, 4.65 percent for food, and 4.46 percent for computers, to 0.06 percent for nonferrous metals, 0.24 percent for ferrous metals, 0.43 percent for lumber, wood and furniture, and 0.62 percent for motor vehicles and parts.

Table 3.12 makes clear the heavy concentration of R&D expenditures among the largest companies as measured by net sales. In our set of 592 firms, $20 billion of the $31.9 billion total R&D expenditures in 1982 were made by the 52 firms with net sales of $5 billion and over. As may be noted in Table 3.13 these firms, which accounted for 66.8 percent of 1982 sales of all of those in the compilation, accounted for only 58.4 percent of the total credit currently claimed. Thus, as seen in Table 3.14, since the percent increases in R&D were least among the firms with sales of $5 billion and over, their shares of the total tentative credit of the firms in the compilation were considerably less than their shares of total R&D: 56.5 percent and 57.3 percent for 1981 and 1982, respectively, for the tentative credit, as against 63.3 percent and 62.6 percent for 1981 and 1982 for R&D.

A concentration of R&D expenditures among the largest firms is also indicated in Table 3.15 where companies are categorized in terms of number of employees. Here we note that 120 companies with 25,000 or more employees, or 20.3 percent of a total of 592 companies in the compilation, accounted for 1982 employment of 8,645,000 or 76.8 percent of total employment, and 1982 R&D expenditures of $25,869 million or 81.0 percent of total R&D. We can see further, in Table 3.16, that the companies with employment of 25,000 or over accounted for 82.0 percent of the total credit currently claimed by firms in our compliation. This last represents a higher proportion than for the tentative credit, which was some 77 and 78 percent in 1981 and 1982, respectively, as shown in Table 3.17. There, we also note that the rates of growth of R&D, both from 1980 to 1981 and from 1981 to 1982 seemed generally lower in the largest firms.

The tax credit estimates presented thus far from Compustat data have all been constructed on the assumption of a constant eligibility ratio. In the special supplementary R&D survey run for us by McGraw-Hill, however, we have received responses regarding qualified expenditures and total company funds for research and development which enable us to estimate eligibility ratios industry-by-industry and year-by-year. We have utilized annual aggregate eligibility ratios derived from these McGraw-Hill responses to estimate qualified expenditures and consequent tax credits with the Compustat data.

Since the McGraw-Hill responses suggest a relatively low eligibility ratio in 1980 and a relatively high one in 1981, estimates of tax credits which are based upon them are generally higher for 1981 than those utilizing a constant eligibility ratio. In Table 3.18, we note that the tentative credit claimed for 1981, making use of these variable eligibility ratios is $586 million, rather than the $465 million estimated on the assumption of a constant eligibility ratio. The credit currently claimed for 1981 rises to $507 million from the $402 million calculated with the constant eligibility ratio. The estimates of $1,028 million and $670 million for tentative credit and credit currently claimed in 1982, respectively, differ little, however, from the estimates prepared on the assumption of a constant eligibility ratio. Table 3.19 presents a distribution of eligible R&D and the tentative credit and percent increases in each by category of 1982 R&D, applying these variable aggregate eligibility ratios. It is thus analogous to Table 3.5, calculated with a constant eligibility ratio. Similarly, Table 3.20, cross-classifying firms by their amount-of-1982-R&D category and their 1981 tax credit situation, it is analogous to Table 3.6, but uses the variable eligibility ratios.

We have also prepared estimates of the tax credit from the aggregates of Compustat R&D expenditures for the years 1980, 1981 and 1982, based to the 1980 NSF total of Company Funds for R&D. Working with the aggregates implies ignoring the limitations: that credits are not negative for companies for which qualifying expenditures are less than their base and that the base can never be less than 50 percent of current qualifying expenditures. The first limitation implies that our aggregate estimates will be less than estimates from individual company expenditures because in the aggregate firms with expenditrues below base will offset some of those with expenditures above base. Failure to take account of the 50 percent base limitation, however, will tend to make the aggregate estimates higher.

In fact, the estimates from aggregates, ignoring limitations, tend to be somewhat less than those calculated by summing estimated credits for individual firms. This is particularly true in 1982, where a larger proportion of firms showed qualifying expenditures below base.

Assuming the usual constant eligibility ratio, the estimate of the tentative tax credit from the aggregates, ignoring limitations, was $451 million for 1981, as against $465 million from the individual firm data, as shown in Table 5.1. For 1982, the estimate from the aggregates is $989 million, as against $1,046 million in the data from individual firms.

Working with the variable eligibility ratios taken from the McGraw-Hill supplementary R&D survey, our estimate from the aggregates of the credit without limitations is $579 million in 1981, almost identical with the $586 million estimate from the individual firm data. For 1982, our estimate from the aggregates is $960 million, as against $1,028 million from the individual firm data.

We have undertaken some preliminary exploration of cross-sectional relations among R&D, sales and net income. Regressions of R&D on lagged R&D, changes in R&D, sales, sales changes and net income are shown in Table 3.21 for 1980, 1981 and 1982.

The cross-sectional differences in R&D are overwhelmingly explained by previous R&D and the previous change in R&D. To the extent that the tax credit is encouraging firms with increasing R&D to increase their R&D still more, we might expect higher coefficients of the lagged change-in-R&D variable in 1981 and 1982 than in 1980. It is apparent that this is not so, although the change-in-R&D variable does have a higher coefficient in 1982, when the credit was in effect for the entire year and increased expenditures did less to lower the future base and hence reduce future credits than they did in 1981.

One might have expected that if the tax credit were effective in increasing R&D expenditures the coefficients of the current net income variable, which would include tax credits, would be higher in 1981 and 1982 than in 1980. This too was not the case.

We observe also that both the sales change and net income variables are positively related to R&D expenditures, suggesting accelerator and profitability determinants of R&D spending. To the extent that these determinants were dominant, the possible role of marginal tax credits might be reduced.

As we have noted in section I, while the tax credit may have some effect of increasing R&D expenditures for firms over base, it may also induce firms under base to lower qualified R&D spending in the interest of securing credits in the future. To test this hypothesis, we ahve compared R&D spending below and above "base" for the years 1976 to 1980, before the incremental tax credit was in effect and the years 1981 and 1982 when the credit was operative. We define the "base" for all years alternatively as that applicable for 1981, that is, half of the (qualified) R&D expenditures of the previous year, and as that in effect for 1982, half of the (qualified) R&D expenditures of the two previous years. In the comparisons in terms of the 1981-type base, we take as R&D expenditures qualified for the credit the imputation of second-half-of-year expenditures defined in (3.1).

As may be seen in Table 3.22, we can find no evidence of effect of the incremental tax credit in this test. The differences between the mean excess of R&D over "base" and the mean shortfall of R&D below "base" are expressed as percents of previous R&D. They turn out to be no greater, and indeed somewhat smaller, by either measure of base, in the years 1981 and 1982 than in the five years before 1981 when there was no incremental tax credit.

A substantial amount of further statistical analysis of the Compustat data, utilizing both time series and cross sections, will be undertaken in an effort to detect possible effects of the tax credit on R&D.

IV. MC GRAW-HILL DATA

The special supplementary R&D survey undertaken on our behalf by McGraw-Hill brought responses from 81 firms who indicated the R&D tax credit that they claimed in 1981 along with the R&D expenditures. Blowing up these responses in accordance with (the reciprocal of) the ratio of the sum of R&D expenditures reported and the NSF estimate of company funds for R&D in each industry for 1980 (NSF, 1983b, Table B-5), yields an estimate of the tax credit of $684 million, as shown in Table 4.1.

It is unfortunately not clear whether the tax credits reported were restricted to those currently claimed or included as well credits carried back or forward because of lack of current federal taxes payable. Interpreting these answers as relating to the "tentative credit," whether or not there were tax liabilities, the resultant estimate is still high in comparison with the estimate of $465 million from Compustat data and even with the estimates from OTA data. There the tentative credit, it may be recalled, came to $408 million from a sample thought to be 80 percent complete although, as noted above, Treasury Assistant Secretary Chapoton presented an estimate of $600 million.

The blowup of 77 McGraw-Hill firms reporting tax credits for 1982 came to only $884 million, however, which is less than the $1,046 million tentative credit estimated from the Compustat tape, although more than the $682 million currently claimed. In terms of internal consistency, the rate of growth of the reported credit from 1981 to 1982, only 29 percent, is extremely low in relation to both analytical predictions and calculations from the Compustat data on assumptions of constant eligibility ratios.

Results substantially similar to those in direct reports of the credit are derived when we calculate it on the basis of qualified expenditures, reported by a slightly smaller number of respondents. These expenditures when blown up to national aggregates, as shown in Table 4.2, would appear to have grown only by 7.89 percent in 1981 and 7.56 percent in 1982. The survey questionnaire asked, however, for "qualified research expenses used in base period calculations" and further stipulated, "Please enter annual or annualized amounts; for the 1981 credit only half-year base percents were used." Thus, as in our estimates with the Compustat annual data, we imputed second-half-of-year figures from year-over-year growth. In this instance we compute 1981 qualified R&D expenditures after June 30 as (4.1) $RDQ81\text{—}II = RDQ81/[RDQ80/RDQ81)^{.5}\ 1]$, where RDQ81 and RDQ80 are qualified R&D expenditures in 1981 and 1980, respectively.

As indicated in Table 4.3, with these imputations for 1981 expenditures after June 30, the tentative credit in 1981 comes to $634 million. It then rises only to $907 million in 1982, falls to $809 million in 1983 and rises again to $952 million in 1984.

In Table 4.4 we present total R&D projections derived from responses in the R&D section of the main McGraw-Hill capital expenditure survey. In Table 4.5, assuming again a constant eligibility ratio of 0.6329144 for all years, we show tentative credits from a sample of 205 firms blown up to NSF nationwide totals. For 1981, the tentative credit estimate of $442 million is close to the Compustat figure of $465 million but well below the $634 million from the reported qualifying expenditures of the smaller number of 78 firms in the McGraw-Hill supplementary R&D survey. For 1982, however, our projected tentative credit from the 205 firms in the capital expenditure surey is $974 million, consistent on the one hand with the greater lag in the 1982 base and, on the other, the decline in the year-over-year rate of growth of R&D expenditures, from 16.51 percent from 1980 to 1981 to 11.68 percent from 1981 to 1982. The forecast expenditures in the McGraw-Hill surveys would then indicate additional growth in the tentative credit to $1,477 million in 1983, essentially because of a further lengthening in the lag of the base, but a moderate decline to $1,308 million in 1984 and a further decline to $1,238 million in 1985, reflecting the cumulative consequences of a slackened projected growth of R&D.

We next assume that eligibility ratios for all firms were identical in each year but changed from year-to-year as did the ratios of the aggregates of qualifying expenditures and total company-funded expenditures from intersecting supplementary-R&D-survey subsets of 74 firms reporting this information for the years 1980 to 1982 and 52 firms reporting for the year 1982 to 1984. Results of the consequent calculations, shown in Table 4.6, suggest a tentative tax credit of $586 million in 1981, $954 million in 1982, $1,388 million in 1983, $1,307 million in 1984 and $1,281 million in 1985 (this last on the assumption of the same eligibility ratio in 1985 as in 1984).

We have utilized NSF estimates of industrial R&D for the years 1980 through 1984 to supplement the estimates of future tax credits from the McGraw-Hill data. The results are estimates of the credit without limitations calculated from these aggregative NSF data as shown in Table 4.7. We may note first that the estimates from these aggregates for the years 1981 and 1982 are quite close to the Compustat estimates for these years. Estimates for future years of course depend critically on forecast growth in nominal R&D. Estimates from the NSF projections, assuming our constant eligibility ratio, were $491 million of tax credit without limitations in 1981, $1,019 million in 1982, $1,354 million in 1983 and $1,513 million in 1984. Estimates prepared on the basis of the variable eligibility ratios from the McGraw-Hill supplementary R&D survey prove sensitive to the high eligibility ratio in 1981. The estimated credit without limitations would rise from $620 million in 1981 to $995 million in 1982, more slowly to $1,197 million in 1983 and then more rapidly again to $1,529 million in 1984.

Responses to the McGraw-Hill supplementary R&D survey permit certain suggestive tests of the effect of the incremental tax credit on R&D expenditures. As shown in Table 4.8, among 71 reporting firms, the mean growth in total R&D in 1981 was 15.8 percent. For 64 firms reporting, the ratio of the change in qualifying R&D to total previous R&D was 21.3 percent. The similar ratio for nonqualifying expenditures was −4.4 percent. If we were to treat these as a sample, the differences in rates of change in qualifying and nonqualifying expenditures would clearly be statistically significant as the standard error of that difference of 25.7 percent is only 5.0 percent.

The regression coefficients indicate an analogous story for 1981. The cross-section coefficient of 5.051 of the change in qualified expenditures on the tax credit is clearly significant. The regression coefficient of the tax credit for nonqualified R&D expenditures is in fact negative although the difference from zero is not statistically significant.

The differences for 1982 are not nearly as striking. The mean rate of growth of R&D was only 10.2 percent. The change in qualified R&D divided by lagged total R&D was 8.6 percent while a corresponding ratio for nonqualified R&D was 2.1 percent. Where there had been a difference of 25.7 percent in 1981 there was thus a difference of only 6.5 percent in 1982. The cross-section regression coefficient of qualified R&D on the tax credit was a smaller but still highly significant 3.467 while that for nonqualified R&D was virtually zero.

What these relationships suggest is that there was a substantial surge in R&D reported to be qualified in 1981. The tax credit was of course, as its definition requires, greater the greater was the growth in qualified R&D. That growth in qualified R&D, however, was considerably offset by a reduction in non-qualified R&D. One might infer that the tax credit was effective in inducing an increase in qualified R&D and a substitution of qualified R&D for non-qualified R&D. One might also infer, alternatively, that there is little evidence of any real impact on R&D, but rather a reclassification of R&D so that a considerably larger portion of the total was classified as qualified in 1981 than in 1980.

With the big increase in the eligibility ratio in 1981, however, there was little room for further growth in qualified R&D relative to total R&D. Hence the difference in rates of increase between qualified and nonqualified R&D very greatly narrowed in 1982.

V. CONCLUSIONS

Our analytical section has indicated a number of the prime characteristics of the incremental tax credit for R&D.

For one thing, it can be expected to grow rapidly in amount over its first three years, 1981, 1982 and 1983. Much of the growth from 1981 to 1982 is obviously foreordained by the fact that the 1981 credit applies only to expenditures after June 30. The progressive lengthening of the lag of the base over all of the first three years, however, offers predictable consequences of increases in the credit, magnified in the context of generally growing expenditures.

Second, the amount of the credit is senstitive to nominal rates of growth of R&D, whether due to real growth or inflation. A credit may be earned by firms which are merely paying more for the same or even less R&D than previously.

Third, the amount of credit is sensitive to changes in the eligibility ratio, that is the proportion of total R&D deemed or accepted as qualified. Proportionally small reclassifications of expenditures as qualified for credit will cause proportionately large changes in the credit.

Fourth, the shifting, company-specific nature of the base reduces drastically the incentive effect of the credit. Since increasing current expenditures reduces future credits, the effective rate of credit, taking into account the present value of future losses of credit, is far lower than the nominal 25 percent rate of current credit. With 1981 expenditures counting as half of the base for 1982 as well as one-third of the bases for 1983 and 1984, the effective rate of credit in 1981 is indeed generally close to zero. For later years the effective rate of credit for firms with tax liabilities and increasing R&D is in the order of only a few percent.

Fifth, for a number of firms the effective rate of credit is negative. This occurs in particular where R&D is already below base and the credit is not sufficient to induce an increase of expenditures to a level above base. Firms in such a situation maybe induced by the existence of the credit to lower current expenditures, on which no credit is earned in any event, in order to lower the base for future years and thus earn a credit or greater credit then.

A second category of firms for which the effective rate of credit may be negative includes companies where qualifying expenditures are more than 100 percent over base. Since these firms in effect raise their current base by 50 cents with each dollar of additional expenditures their current tax credit is actually at a rate of only 12.5 percent instead of 25 percent. With future bases being fully raised by current expenditures, their loss in future credits with any reasonable rate of discount is more than the current gain.

In addition, firms with no federal income taxes currently payable and also unable to take advantage of the three-year carry-back provision may lose the advantage of the credit. If a carry-forward of one or two years is necessary, the present value of tax savings is reduced. If the carry forward is three years, the effective rate of credit is brought to zero.

We have analyzed vast amounts of data from the Office of Tax Analysis of the U.S. Treasury Department, Standard and Poor's Compustat tape and tabulations, and individual company responses from both the regular McGraw-Hill spring surveys and a special supplementary R&D survey undertaken for us. Results of the analysis serve generally to flesh out our analytical predictions.

The "tentative tax credit," ignoring the issue of current tax liabilities against which it would have to be offset, appeared to run in the broad neighborhood of $500 million in 1981 and roughly double that in 1982, despite the slackening rate of growth in R&D in that year. Forecasts of the future tax credit suggest some further increase in 1983, but the forecasts for 1984 are mixed.

A considerable number of firms, accounting for substantial proportions of R&D expenditures, fall into categories for which the effective credit is negative or zero. In 1982, for example, 128 firms out of 592 in our Compustat sample, accounting for 15.3 percent of R&D expenditures in that group, appeared to have R&D equal to or below base. These firms could benefit by reducing current expenditures. An additional 154 firms, accounting for no less than 32.1 percent of total R&D expenditures, had no federal income taxes payable in 1982. What they will gain from the credit will depend upon in which direction and how far it will have to be carried.

The OTA data indicated a huge falloff for 1981, of some 43 percent, from tentative credit to credit currently claimed. The corresponding figure for 1981 estimated from the Compustat data was only about 14 percent. If the OTA data are in fact correct for 1981, the trend in the Compustat data for 1981 to 1982 suggests that perhaps well over half of 1982 R&D would have been undertaken by firms unable to claim the credit in 1982 because of lack of tax liabilities in that year.

The sensitivity of the credit to eligibility ratios is supported in several bits of evidence. First, the direct estimates of the 1981 credit from both OTA and McGraw-Hill data are significantly larger than is indicated in either Compustat or McGraw-Hill R&D tabulations. This suggests that firms did indeed increase their eligibility ratios in 1981 as against 1980. That may have been accomplished by counting as qualified R&D in 1981 expenditures that had not been so classified in 1980. It may also have been accomplished by crediting to the second half of 1981 expenditures for goods and services which in 1980 were spread relatively evenly over the year. Firms in a position to do this could enjoy a greater 1981 tax credit without increasing the base and thus reducing credits in future years. The answers to explicit questions in the McGraw-Hill supplementary R&D survey dealing with qualified and total company-financed R&D expenditures do in fact suggest a sharply higher eligibility ratio in 1981.

The R&D tax credit, like R&D expenditures themselves, is concentrated heavily among firms which are large, whether measured in terms of R&D expenditures, sales or number of employees. The concentration of the credit is somewhat less among large firms than is R&D itself, however, because R&D is apparently growing proportionately somewhat less among large firms.

Efforts to find in the data measures of the effectiveness of the tax credit are still very preliminary. Analytical considerations suggest that the effectiveness may indeed be hard to detect, partly because the credit is by its definition tied to increases in R&D, whether it causes them or not, and partly because the effective rate of credit is generally small, and in many instances zero or negative. Our data appear consistent with the view that levels of current R&D expenditures are largely accounted for by previous R&D levels and broadly determining economic conditions such as sales and profitability.

By one hypothesis the credit, if it were affecting firms' decisions, might have been expected to result in greater increases in R&D by firms with R&D above base and lesser increases, or greater decreases, for firms with R&D below base. A comparison of such increases and decreases in R&D for the years 1976 to 1980, before the adoption of the tax credit, and the years 1981 and 1982, did not indicate that the credit was having this impact.

A comparison of changes in qualified and nonqualified R&D and their relations with the tax credit indicates a substantial upsurge in R&D reported as qualified in 1981, significantly offset by a decline in nonqualified R&D. Qualified R&D apparently increased somewhat more rapidly than nonqualified R&D in 1982 but the growth in total R&D decreased sharply.

We have thus as yet been unable to detect reliable evidence that the credit is having a positive impact on total R&D expenditures. Our analysis is still too incomplete, however, to sustain any definite conclusion on this issue.

While companies interested in tax benefits would understandably wish to see the credit extended, analytical considerations indicate that the credit will become increasingly effective in 1983, 1984 and 1985 if it is not expected to be extended. For if firms do not anticipate that the credit will be extended, the loss of future credits as a result of increasing current expenditures will be reduced by one-third for expenditures undertaken in 1983, by two-thirds for expenditures undertaken in 1984 and entirely for expenditures undertaken in 1985. By that last year, for firms with tax liability and with qualified R&D above base but less than 100 percent above base, the effective rate of credit would be raised to the full 25 percent.

Without judging the issue as to whether any R&D tax credit is socially desirable, certain revisions would seem likely to improve the one currently in effect.

First, while the 50 percent limitation does not apparently relate to a large proportion of R&D, its negative incentive effects can be considerable where it does come into play. To the extent that our major concern is for increasing R&D expenditures and not for distributing the benefits of reduced taxes in some more egalitarian fashion, it would appear that the 50 percent base limitation might well be removed. If it is not entirely removed, at the least, future bases should take into account the limitation on the current base. Where the 50 percent limitation is currently in force, each dollar of current qualified expenditure in excess of base might better generate only 50 cents toward increasing future bases. This would eliminate the anomaly by which, for firms in this category, each dollar increase in R&D expenditures would generate only 12.5 cents in current credit while losing 25 cents in future credits.

A second significant revision, in the interest of increasing incentives, would entail eliminating or reducing the asymmetry as between firms with R&D above base and firms with R&D below base. This might of course be accomplished directly by levying a negative credit, or an additional tax, equal to 25 percent of reductions in qualified R&D spending. Since this would certainly be viewed with extreme distaste by firms affected, a more practical solution would be to combine such a tax for declining R&D with a general credit on all R&D over, say, 80 percent of base. Thus firms with decreasing R&D would lose some of the general credit and would hence be discouraged from such reductions, but might never have to pay a net tax relating to R&D.

The most important and fundamental revision, however, would relate to altering the moving, company-specific nature of the base. It is this feature which results in firms generally losing dollar for dollar in future credits the amounts that they gain in current credits from increasing their R&D expenditures. Under the current law, firms whose R&D is increasing and expected to increase over base within the zero to 100 percent range, and who have and expect to have tax liabilities to be offset, in effect gain only the interest savings of postponing taxes over a three year period, rather than eliminating them.[4]

Several methods are available which would alter this provision in the interest of increasing the effective incentive. First, the company-specific base could be retained but left fixed at, say, the average of 1980, 1981 and 1982 qualified R&D expenditures (with possibly some exceptions or adjustments for new firms). This would imply rapidly growing amounts of R&D credits over the years but would mean that the effective rate of credit would be equal to the statutory rate for firms which have current tax liabilities and are not subject to the 50 percent base limitation. It would also generally offer an incentive to firms to minimize their reductions in R&D.

Somewhat more complicated to administer, but less costly in terms of tax revenues, would be a provision to start with a company-specific base, say of R&D expenditures of 1980, 1981 and 1982, but to adjust that base in accordance with national or industry movements in R&D. Thus if a firm were in an industry where R&D in 1983 grew by 10 percent, its base in calculating its R&D tax credit for 1984 would be raised by 10 percent. The credit for each firm would hence relate to increases in R&D spending over a base which is both company-specific but adjusting to movements of R&D among companies in similar situations. Unless the industry were unduly small in relation to the size of the firm—and this could be avoided by appropriate grouping of industries—each firm would have a full 25 percent effective credit as an incentive to increase its expenditures. Its increased expenditures would contribute to raising the base and reducing future credits for everybody but would have a trivial effect in raising its own base and reducing its own future credits. By having the base increase on the basis of industry experience rather than company-specific experience, we would achieve the maximum incentive impact along with the minimal Treasury tax loss associated with an incremental credit.

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[4] These interest savings would, however, prove a perpetual stream if the indicated conditions remain in effect.

Finally, the impact of the R&D tax credit would be increased by making it refundable or a direct subsidy rather than a credit. This would mean that the considerable number of firms in the economy not paying federal income taxes would also have an incentive to increase R&D spending. With the vastly increased depreciation deductions implicit in the accelerated cost recovery system, the investment tax credit and credits for foreign taxes, we have reached the point where many existing credits, let alone new ones, can be realized only by selling or merging firms. Unless we are to restore the corporate income tax by eliminating most or all of the existing incentives, deductions or loopholes, depending on one's view, new credits such as those for R&D would have to be refundable, regardless of taxes, to avoid significant losses of whatever incentive effects they have.

Alternatively, and this may well be a better path to take, the corporate income tax as such might be eliminated, presumably with shares in real corporate earnings attributed to the individual stockholders. The business tax incentives or "tax expenditures" might be eliminated and we could readily move to direct subsidies of those private expenditures and activities which we find it in the social interest to encourage.

TABLE 2.1.—OFFICE OF TAX ANALYSIS RETURNS FOR 1981: BASE, QUALIFIED R&D, CREDIT WITHOUT LIMITATIONS, LIMITATION LOSSES, TENTATIVE CREDIT, TAX LOSS, CREDIT CURRENTLY CLAIMED, AND RATE OF GROWTH OF QUALIFIED R&D OVER BASE, BY INDUSTRY

[Dollars in thousands]

Industry	SOI	Base	Qualified R&D	Credit without limitations	Limitation losses	Tentative credit	Tax loss	Credit currently claimed	QR&DG (percent)
Agriculture	$400	$4,135	$8,303	$1,042	$366	$676	$639	$37	101
Agricultural services	600	7,821	10,800	745	26	719	108	611	38
Oil and gas drilling	1,330	4,704	12,154	1,863	430	1,433	1,356	77	158
Oil and gas field services	1,380	7,009	16,022	2,253	465	1,788	383	1,405	129
Mining	1,400	3,721	7,960	1,060	246	814	719	95	114
Construction	1,500	7,453	15,825	2,093	536	1,557	393	1,164	112
Meat products	2,010	1,748	3,090	336	68	268	19	249	77
Dairy products	2,020	1,209	2,088	220	41	179	38	141	73
Preserved fruits and vegetables	2,030	3,438	5,669	558	36	522	220	302	65
Grain milling	2,040	12,521	16,045	881	30	851	11	840	28
Bakery, sugar, confections	2,050	4,362	6,181	455	53	402	42	360	42
Alcoholic beverages	2,080	8,986	11,856	718	26	692	72	620	32
Other food; tobacco	2,090	23,716	33,880	2,541	862	1,679	892	787	43
Weaving mills	2,228	1,799	2,474	169	1	168	79	89	38
Knitting mills	2,250	264	949	171	52	119	38	81	259
Other textiles	2,298	11,158	16,041	1,221	48	1,173	287	886	44
Apparel	2,300	11,051	17,256	1,551	353	1,198	93	1,105	56
Logging and wood products	2,400	23,075	31,199	2,031	197	1,834	1,092	742	35
Furniture	2,500	8,766	12,493	932	94	838	61	777	43
Paper	2,600	117,235	163,627	11,598	330	11,268	1,848	9,420	40
Newspapers and periodicals	2,700	3,459	7,681	1,056	176	880	425	455	122
Books and other publishing	2,735	1,008	2,260	313	59	254	85	169	124
Commercial printing	2,799	9,367	16,463	1,774	263	1,511	78	1,433	76
Industrial chemicals	2,815	381,304	500,716	29,853	425	29,428	11,556	17,872	31
Drugs	2,830	243,145	398,592	38,862	18,796	20,066	8,994	11,072	64
Soap products	2,840	27,252	39,803	3,138	174	2,964	148	2,816	46
Paints	2,850	12,266	15,643	844	46	798	161	637	28
Agricultural and other chemicals	2,898	50,314	60,618	2,576	109	2,467	1,110	1,357	20

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[Dollars in thousands]

Industry	SOI	Base	Qualified R&D	Credit without limitations	Limitation losses	Tentative credit	Tax loss	Credit currently claimed	QR&DG (percent)
Refining	2,900	129,595	197,829	17,059	97	16,962	745	16,217	53
Rubber	3,050	81,723	102,082	5,090	39	5,051	299	4,752	25
Plastic	3,070	9,831	23,078	3,312	1,305	2,007	1,019	988	135
Leather	3,100	1,169	3,134	491	156	335	40	295	168
Glass	3,225	32,564	41,445	2,220	85	2,135	175	1,960	27
Cement and concrete	3,240	1,432	3,200	442	107	335	151	184	123
Other stone, clay, et cetera	3,298	19,756	27,339	1,896	288	1,608	1,003	605	38
Steel	3,370	45,161	60,188	3,757	205	3,552	2,790	762	33
Nonferrous metals	3,380	22,288	28,065	1,444	210	1,234	836	398	26
Containers	3,410	3,541	4,103	141	12	129	0	129	16
Hand tools, hardware, cutlery	3,428	5,284	10,608	1,331	398	933	278	655	101
Plumbing	3,430	5,171	7,160	497	27	470	17	453	38
Structural metal	3,440	10,292	18,105	1,953	283	1,670	435	1,235	76
Forgings and stampings	3,460	3,777	6,070	573	75	498	54	444	61
Engraving, coating, et cetera	3,470	2,648	4,144	374	0	374	234	140	56
Ordnance	3,480	1,125	1,546	105	0	105	0	105	37
Miscellaneous fabricated metal	3,490	15,058	25,990	2,733	−201	2,934	1,896	1,038	73
Farm machinery	3,520	72,009	81,788	2,445	173	2,272	477	1,795	14
Construction machinery	3,530	203,860	260,705	14,211	2,651	11,560	2,233	9,327	28
Metalworking machinery	3,540	39,384	57,732	4,587	297	4,290	1,482	2,808	47
Special industrial machinery	3,550	21,956	36,426	3,618	329	3,289	1,169	2,120	66
General industrial machinery	3,560	33,229	47,852	3,656	537	3,119	162	2,957	44
Office and computing machinery	3,570	283,073	383,587	25,129	631	24,498	8,377	16,121	36
Other nonelectrical machinery	3,598	31,812	48,576	4,191	260	3,931	3,000	931	53
Radio and television	3,611	114,137	171,123	14,247	778	13,469	2,913	10,556	50
Household appliances	3,630	15,954	20,931	1,244	123	1,121	476	645	31
Electronic components, et cetera	3,670	206,467	345,101	34,659	7,059	27,600	17,253	10,347	67
Other electrical equipment	3,698	293,139	360,763	16,906	2,307	14,599	2,232	12,367	23
Motor vehicles and equipment	3,710	561,435	684,440	30,751	163	30,588	26,332	4,256	22
Areospace	3,725	403,386	519,034	28,912	1,709	27,203	13,926	13,277	29
Shipbuilding	3,730	2,276	4,236	490	23	467	290	177	86
Other transportation equipment	3,798	6,022	8,483	615	44	571	134	437	41
Scientific instruments; clocks	3,815	122,590	179,967	14,344	1,804	12,540	3,419	9,121	47
Optical and medical goods	3,845	37,713	58,374	5,165	816	4,349	1,203	3,146	55

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[Dollars in thousands]

Industry	SOI	Base	Qualified R&D	Credit without limitations	Limitation losses	Tentative credit	Tax loss	Credit currently claimed	QR&DG (percent)
Photographic equipment	3,860	164,575	218,007	13,358	436	12,922	8,764	4,158	32
Other manufacturing	3,998	81,423	122,197	10,194	2,127	8,067	4,135	3,932	50
Transportation services	4,000	20,217	36,157	3,985	827	3,158	2,581	577	79
Communications	4,800	10,909	23,193	3,071	634	2,437	627	1,810	113
Utilities	4,900	177,826	251,559	18,433	471	17,962	11,417	6,545	41
Grocery wholesaling	5,004	721	3,036	579	238	341	23	318	321
Machinery wholesaling	5,008	20,002	32,831	3,207	638	2,569	1,510	1,059	64
Motor vehicle wholesaling	5,010	1,797	11,584	2,447	1,552	895	145	750	545
Other durables wholesaling	5,020	6,180	31,737	6,389	2,654	3,735	493	3,242	414
Electrical goods wholesaling	5,060	4,108	11,545	1,859	696	1,163	895	268	181
Paper wholesaling	5,110	607	1,658	263	47	216	11	205	173
Drug wholesaling	5,129	2,673	3,634	240	36	204	93	111	36
Apparel wholesaling	5,130	1,542	3,532	498	57	441	0	441	129
Chemical and oil wholesaling	5,160	3,302	6,239	734	163	571	225	346	89
Food and miscellaneous wholesaling	5,190	3,917	7,674	939	222	717	301	416	96
Hardware and building materials	5,220	467	978	128	26	102	28	74	109
Food retailing	5,300	9,195	14,526	1,333	262	1,071	64	1,007	58
Auto dealers and service stations	5,500	1,170	2,098	232	42	190	93	97	79
Apparel stores	5,600	1,470	2,653	296	6	290	130	160	80
Furniture stores	5,700	121	311	48	13	35	5	30	157
Restaurants	5,800	238	516	70	13	57	15	42	117
Drug stores	5,912	83	494	103	47	56	0	56	495
Other retailing	5,995	5,264	14,085	2,205	756	1,449	152	1,297	168
Banking	6,000	19,543	38,697	4,789	1,052	3,737	2,646	1,091	98
Credit agencies; brokers	6,100	9,827	21,519	2,923	501	2,422	1,174	1,248	119
Life insurance	6,355	19,591	30,987	2,849	559	2,290	425	1,865	58
Other insurance	6,359	14,619	33,772	4,788	2,337	2,451	1,897	554	131
Insurance agents	6,411	1,256	4,306	763	249	514	1	513	243
Real estate investment cos	6,511	7,030	22,301	3,818	1,283	2,535	329	2,206	217
Lodging; personal services	7,000	1,110	3,458	587	175	412	89	323	212
Advertising and business services	7,300	73,196	167,726	23,633	6,054	17,579	10,450	7,129	129
Repair services (including auto)	7,500	1,548	5,546	1,000	432	568	3	565	258
Amusement and recreation services	7,800	1,522	3,198	419	163	256	0	256	110
Medical services	8,000	3,558	7,143	896	271	625	227	398	101
Other services	8,999	16,762	40,407	5,911	1,855	4,056	1,673	2,383	141
Total		4,518,512	6,448,196	482,421	73,984	408,437	176,618	231,819	43

TABLE 3.1.—R&D EXPENDITURE AND TAX CREDIT ESTIMATES FROM BUSINESS WEEK-COMPUSTAT-SEC COMPILATIONS

[In millions of dollars]

Industry	Number of companies	Company R&D expenditures			Tentative tax credits assuming constant eligibility ratio of 0.6329144	
		1980	1981	1982	1981	1982
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Aerospace	15	$2,020	$2,341	$2,517	31	69
Appliances	7	106	134	159	2	6
Automotive: Cars, trucks	5	4,454	4,512	4,527	9	21
Automotive: Parts, equipment	14	291	345	361	6	7
Building materials	17	137	150	156	1	3
Chemicals	41	2,136	2,598	3,020	47	104
Conglomerates	11	1,189	1,266	1,347	11	20
Containers	5	114	121	100	1	1
Drugs	28	2,133	2,508	2,976	38	103
Electrical	29	1,317	1,460	1,502	14	19
Electronics	56	764	922	1,066	17	35
Food and beverages	30	464	553	643	9	21
Fuel	19	1,579	2,079	2,207	50	60
Info. Proc.: Computers	25	3,334	3,845	4,717	51	177
Info. Proc. Office equipment	14	567	709	769	15	22
Info. Proc.: Peripherals, services	36	233	315	406	8	21
Instruments	58	514	605	683	10	20
Leisure time	17	768	883	1,013	12	30
Machinery: Farm, construction	16	663	735	761	7	10
Machinery: Industrial	43	352	404	416	6	8
Metals and mining	13	188	212	211	3	3
Miscellaneous manufacturing	84	1,018	1,152	1,254	14	28
Oil services and supplies	19	493	642	792	15	35
Paper	16	233	256	273	3	6
Personal and home care	21	538	607	710	7	22
Semiconductors	9	415	496	559	8	16
Steel	5	137	174	192	4	6
Telecommunications	15	744	895	1,087	15	42
Textiles and apparel	11	35	40	45	1	1
Tires and rubber	10	397	451	494	6	11
Tobacco	1	21	21	19	0	0
Total in compilation	690	27,355	31,433	34,982	419	928
Total based to 1980 NSF company funds for R&D		30,476	35,019	38,973	467	1,034

TABLE 3.2.—PERCENT INCREASES IN R&D AND TENTATIVE TAX CREDIT FROM BUSINESS WEEK-COMPUSTAT-SEC COMPILATION

Industry	Percent increases in R&D		Percent increase in tentative credit, 1981–82
	1980–81	1981–82	
(1)	(2)	(3)	(4)
Aerospace	15.9	7.5	122.3
Appliances	26.4	19.1	129.5
Automotive:			
Cars, trucks	1.3	.3	151.3
Parts equipment	18.7	4.6	25.2
Building materials	9.2	4.0	91.7

TABLE 3.2.—PERCENT INCREASES IN R&D AND TENTATIVE TAX CREDIT FROM BUSINESS WEEK-COMPUSTAT-SEC COMPILATION—Continued

Industry	Percent increases in R&D		Percent increase in tentative credit, 1981-82
	1980-81	1981-82	
(1)	(2)	(3)	(4)
Chemicals	21.7	16.2	120.8
Conglomerates	6.4	6.4	77.2
Containers	5.8	−16.9	−17.1
Drugs	17.6	18.7	174.6
Electrical	10.9	2.9	32.4
Electronics	20.7	15.6	112.8
Food and beverages	19.3	16.3	133.3
Fuel	31.7	6.2	19.7
Information processing:			
Computers	15.3	22.7	244.9
Office equipment	25.1	8.5	49.4
Peripherals, services	35.1	28.7	155.4
Instruments	17.7	12.9	108.0
Leisure time	15.1	14.7	150.2
Machinery:			
Farm, construction	10.9	3.4	43.0
Industrial	14.7	3.0	32.8
Metals and mining	13.1	.6	31.8
Miscellaneous manufacturing	13.1	8.9	101.8
Oil services and supplies	30.2	23.4	138.3
Paper	10.1	6.5	132.5
Personal and home care	12.9	16.8	209.2
Semiconductors	19.5	12.8	101.2
Steel	27.0	10.1	58.1
Telecommunications	20.3	21.5	173.6
Textiles and apparel	13.9	14.1	164.7
Tires and rubber	13.8	9.4	99.5
Tobacco	−2.4	−9.7	NA
Total in compilation	14.9	11.3	121.5

TABLE 3.3.—R&D EXPENDITURES, 1980, 1981, AND 1982, BY AMOUNT OF R&D CATEGORY, FROM COMPUSTAT TAPE

[Dollars in millions]

Category of 1982 R&D	Number of companies	Company R&D expenditures		
		1980	1981	1982
(1)	(2)	(3)	(4)	(5)
$100 million and over	66	19,328	21,998	24,536
$10 million to $99 million	184	4,724	5,614	6,318
$1 million to $9 million	250	871	999	1,038
Under $1 million	92	49	51	46
Total in compilation	592	24,972	28,661	31,939
Total based to 1980 NSF Company R&D		30,476	34,978	38,979
Qualified R&D [1]		19,289	22,138	24,670

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981, and 1982.

TABLE 3.4—TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, 1981 AND 1982, BY AMOUNT-OF-R&D CATEGORY, FROM COMPUSTAT TAPE

[Dollars in millions]

Category of 1982 R&D	Tentative credit [1] (TNTCRD)		Credit currently claimed [2] (CRDCCL)		CRDCCL divided by TNTCRD (percent)	
	1981	1982	1981	1982	1981	1982
(1)	(2)	(3)	(4)	(5)	(6)	(7)
$100 million and over	$273	$639	$243	$423	89.1	66.2
$10 million to $99 million	92	191	73	116	79.2	60.8
$1 million to $9 million	15	26	12	18	80.8	70.0
Under $1 million	.7	1.0	.6	.8	86.1	78.0
Total in compilation	381	857	329	558	86.4	65.2
Total based to 1980 NSF Company R&D	465	1,046	402	682	86.4	65.2

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981, and 1982.

[2] Assuming CRDCCL=TENTCR if FEDTAX > u; 0 if FEDTAX< 0 where FEDTAX=Federal income taxes currently payable.

TABLE 3.5.—DISTRIBUTION AND PERCENT INCREASES OF R&D AND TENTATIVE CREDIT,[1] BY AMOUNT OF R&D CATEGORY, FROM COMPUSTAT TAPE

Category of 1982 R&D	Percent of total in compilation				Percent increases in R&D		Percent increase in tentative credit 1981–82
	R&D		Tentative credit		1980–81	1981–82	
	1981	1982	1981	1982			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$100 million and over	76.4	76.8	71.7	74.6	13.8	11.5	134.0
$10 to $99 million	19.6	19.8	24.2	22.3	18.8	12.6	107.3
1 to $9 million	3.5	3.3	3.9	3.0	14.7	3.9	74.5
Under $1 million	.178	.144	.193	.114	2.9	−9.9	32.8
Total in compilation	100.0	100.0	100.0	100.0	14.8	11.4	125.0

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981 and 1982.

TABLE 3.6.—R&D AND TAX CREDIT SITUATION BY NSF INDUSTRY AND R&D CATEGORIES, 1981, FROM COMPUSTAT TAPE [1]

Industry or R&D category	Firms with—			Total [2]	Firms with—		
	No current credit				No current credit		
	R&D < Base [2]	R&D > Base but FINTAX < 0[2]	Credit (CRDCCL = TNTCRD) [2]		R&D < Base [3]	R&D > Base but FINTAX < 0[3]	Credit (CRDCCL = TNTCRD) [3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Industry							
Food	$1	$13	$192	$205	0.3	6.4	93.3
	(4)	(2)	(17)	(23)	(−8.5)	(5.3)	(33.9)
Textiles and apparel	$13	$6	$18	$36	34.5	15.4	50.1
	(5)	(5)	(7)	(17)	(−6.1)	(9.2)	(56.5)
Lumber, wood, furniture	$1	$35	$7	$42	1.5	82.5	16.1
	(2)	(2)	(6)	(10)	(−17.4	(4.3)	(18.9)
Paper	$10	$34	$457	$501	2.0	6.8	91.2
	(5)	(5)	(11)	(21)	(−9.7)	(21.0)	(14.2)
Chemicals	$3	$272	$1,658	$1,933	.2	14.1	85.8
	(4)	(4)	(45)	(53)	(−4.0)	(28.8)	(19.0)
Drugs	$0	$7	$820	$827	0	.8	99.2
	(0)	(2)	(16)	(18)	NA	(10.5)	(16.3)
Petroleum refining	$5	$192	$1,077	$1,274	.4	15.1	84.5
	(1)	(4)	(10)	(15)	(−6.1)	(31.0)	(31.9)

TABLE 3.6.—R&D AND TAX CREDIT SITUATION BY NSF INDUSTRY AND R&D CATEGORIES, 1981, FROM COMPUSTAT TAPE[1]—Continued

Industry or R&D category	Firms with—			Total[2]	Firms with—		
	No current credit		Credit (CRDCCL = TNTCRD)[2]		No current credit		Credit (CRDCCL = TNTCRD)[3]
	R&D < Base[2]	R&D > Base but FINTAX < 0[2]			R&D < Base[3]	R&D > Base but FINTAX < 0[3]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Rubber products	$50	$15	$271	$336	14.8	4.6	80.6
	(3)	(2)	(14)	(19)	(−3.7)	(18.1)	(18.3)
Stone, clay, glass products	$24	$31	$114	$169	14.2	18.4	67.4
	(3)	(2)	(6)	(11)	(−4.0)	18.6	(10.5)
Ferrous metals	$2	$0	$119	$122	2.0	0	98.0
	(3)	(0)	(6)	(9)	(−15.2)	NA	(19.1)
Nonferrous metals	$22	$14	$86	$123	17.9	11.8	70.3
	(2)	(2)	(3)	(7)	(−3.3)	(16.8)	(10.2)
Fabricated metal products	$28	$30	$81	$139	20.0	21.4	58.7
	(6)	(2)	(20)	(28)	(−0.8)	(2.9)	(8.1)
Nonelectrical machinery	$121	$105	$741	$967	12.5	10.9	76.6
	(18)	(6)	(44)	(68)	(−12.3)	(29.7)	(20.2)
Computers, office machinery	$5	$63	$2,608	$2,676	.2	2.3	97.5
	(3)	(4)	(37)	(44)	(−10.8)	(24.6)	(16.0)
Electrical equipment	$8	$31	$954	$993	.8	3.1	96.1
	(3)	(2)	(24)	(29)	(−6.7)	(4.9)	(10.8)
Radios, TV's	$122	$1	$243	$366	33.4	.3	66.3
	(1)	(2)	(5)	(8)	(−1.7)	(9.7)	(24.0)
Communication equipment	$322	$25	$415	$762	42.3	3.3	54.4
	(5)	(7)	(23)	(35)	(−0.8	(41.8)	(28.3)
Electronic components	$5	$86	$71	$162	2.0	53.2	43.8
	(5)	(4)	(11)	(20)	(−10.8)	(22.4)	(37.4)
Motor vehicles and parts	$161	$1,165	$1,717	$3,043	5.3	38.3	56.4
	(3)	(5)	(9)	(17)	(−10.3)	(3.3)	(3.1)
Other transportation	$16	$0	$7	$23	68.1	0	31.9
	(2)	(0)	(3)	(5)	(−12.4)	NA	(28.4)
Aircraft, missiles	$78	$200	$1,195	$1,474	5.3	13.6	81.1
	(3)	(6)	(9)	(18)	(−12.3)	(123.2)	(10.5)
Scientific measuring instruments.	$21	$38	$143	$202	10.2	19.0	70.9
	(8)	(6)	(13)	(27)	(−7.0)	(27.7)	(21.0)
Optical, surgical, and other instruments.	$26	$1	$828	$855	3.0	.1	96.9
	(3)	(1)	(9)	(13)	(−10.5)	(56.8)	(18.7)
Other manufacturing	$31	$0	$43	$74	41.2	.5	58.4
	(4)	(1)	(17)	(22)	(−13.3)	40.0	15.7
Nonmanufacturing	$40	$16	$772	$828	4.9	1.9	93.2
	(14)	(5)	(28)	(47)	(−25.3)	(27.2)	(28.9)
Uncoded	$1	$2	$4	$7	13.1	27.5	59.4
	(2)	(2)	(4)	(8)	(−28.2)	(13.2)	(104.9)
Total in compilation	$1,115	$2,383	$14,642	$18,140	6.1	13.1	80.7
	(112)	(83)	(397)	(592)	(−7.1)	(17.0)	(16.5)
B. R&D in 1982							
$100 million and over	$654	$1,666	$11,603	$13,923	4.7	12.0	83.3
	(4)	(5)	(57)	(66)	(−4.4)	(13.1)	(15.1)
$10 million to $99 million	$333	$639	$2,581	$3,553	9.4	18.0	72.6
	(19)	(33)	(132)	(184)	(−9.6)	(26.4)	(22.0)
$1 million to $9 million	$113	$75	$444	$632	17.9	11.8	70.2
	(46)	(34)	(170)	(250)	(−12.3)	(33.6)	(21.4)
Under $1 million	$15	$3	$14	$32	45.6	10.7	43.7
	(43)	(11)	(38)	(92)	(−22.0)	(24.1)	(45.3)

TABLE 3.6.—R&D AND TAX CREDIT SITUATION BY NSF INDUSTRY AND R&D CATEGORIES, 1981, FROM COMPUSTAT TAPE[1]—Continued

Industry or R&D category	Firms with—			Total[2]	Firms with—		
	No current credit		Credit (CRDCCL = TNTCRD)[2]		No current credit		Credit (CRDCCL = TNTCRD)[3]
	R&D < Base[2]	R&D > Base but FINTAX < 0[2]			R&D < Base[3]	R&D > Base but FINTAX < 0[3]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Total in compilation	$1,115	$2,383	$14,642	$18,140	6.1	13.1	80.7
	(112)	(83)	(397)	(592)	(−7.1)	(17.0)	(16.5)

[1] Using constant eligibility ratio of 0.6329144.
[2] Millions of dollars of R&D (number of companies).
[3] Percent of total R&D (Percent growth in R&D, 1980-81).

TABLE 3.7.—R&D AND TAX CREDIT SITUATION BY NSF INDUSTRY AND R&D CATEGORIES, 1982, FROM COMPUSTAT TAPE[1]

Industry or R&D category	Firms with—			Total[2]	Firms with—		
	No current credit		Credit (CRDCCL = TNTCRD)[2]		No current credit		Credit (CRDCCL = TNTCRD)[3]
	R&D< Base[2]	R&D > Base but FINTAX < 0[2]			R&D< Base[3]	R&D > Base but FINTAX < 0[3]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Industry							
Food	$10	$22	$197	$229	4.2	9.8	86.0
	(1)	(7)	(15)	(23)	(−9.6)	(17.4)	(12.2)
Textiles and apparel	$4	$19	$18	$41	9.6	45.5	44.9
	(4)	(3)	(10)	(17)	(−14.6)	(20.6)	(11.1)
Lumber, wood, furniture	$35	$0	$3	$38	92.8	0	7.2
	(5)	(0)	(5)	(10)	(−11.0)	NA	(27.4)
Paper	$25	$75	$497	$597	4.2	12.6	83.2
	(3)	(10)	(8)	(21)	(−11.3)	(14.3)	(22.1)
Chemical	$45	$1,265	$979	$2,288	1.9	55.3	42.8
	(8)	(13)	(32)	(53)	(−26.9)	(23.6)	(15.3)
Drugs	$0	$13	$946	$959	0	1.3	98.7
	(0)	(4)	(14)	(18)	NA	(51.0)	(15.6)
Petroleum refining	$135	$0	$1,203	$1,338	10.1	0	89.9
	(3)	(0)	(12)	(15)	(−15.7)	NA	(8.0)
Rubber products	$34	$86	$240	$360	9.5	23.9	66.7
	(4)	(3)	(12)	(19)	(−9.7)	(3.7)	(11.2)
Stone, clay, glass products	$53	$66	$50	$169	31.3	39.0	29.7
	(5)	(3)	(3)	(11)	(−8.3)	(2.8)	(13.7)
Ferrous metals	$40	$62	$31	$132	30.0	46.8	23.2
	(5)	(2)	(2)	(9)	(−8.6)	(30.5)	(−2.0)
Nonferrous metals	$17	$109	$3	$129	13.2	84.6	2.2
	(1)	(5)	(1)	(7)	(−12.7)	(8.4)	(13.9)
Fabricated metal product	$65	$5	$59	$129	50.2	3.8	45.9
	(10)	(3)	(15)	(28)	(19.4)	(3.9)	(10.9)
Nonelectrical machinery	$130	$559	$318	$1,007	12.9	55.5	31.6
	(22)	(20)	(26)	(68)	(−12.4)	(.9)	(20.3)
Computers, office machinery	$1	$908	$2,331	$3,239	0	28.0	72.0
	(3)	(13)	(28)	(44)	(−69.1)	(12.4)	(24.9)
Electrical equipment	$530	$32	$461	$1,023	51.8	3.1	45.1
	(6)	(3)	(20)	(29)	(−4.5)	(23.3)	(11.9)
Radios, TV's	$22	$164	$207	$394	5.6	41.8	52.6
	(2)	(3)	(3)	(8)	(−2.8)	(3.2)	(12.6)
Communication equipment	$10	$189	$669	$868	1.1	21.8	77.1
	(4)	(15)	(16)	(35)	(−7.2)	(25.3)	(11.4)
	(2)	(8)	(10)	(20)	(−2.4)	(14.3)	(21.2)
Electronic components	$1	$99	$90	$190	.5	52.1	47.4

TABLE 3.7.—R&D AND TAX CREDIT SITUATION BY NSF INDUSTRY AND R&D CATEGORIES, 1982, FROM COMPUSTAT TAPE [1]—Continued

Industry or R&D category	Firms with—			Total [2]	Firms with—		
	No current credit				No current credit		
	R&D Base [2]	R&D Base but FINTAX 0 [2]	Credit (CRDCCL = TNTCRD) [2]		R&D Base [3]	R&D > Base but FINTAX 0 [3]	Credit (CRDCCL = TNTCRD) [3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Motor vehicles and parts	$1,381	$1,466	$301	$3,147	43.9	46.6	9.6
	(4)	(6)	(7)	(17)	(−3.3)	(6.1)	(28.9)
Other transportation	$13	$5	$2	$20	67.0	24.1	8.9
	(3)	(1)	(1)	(5)	(−18.9)	(−7.0)	(48.3)
Aircraft, missiles	$437	$423	$797	$1,657	26.4	25.5	48.1
	(1)	(7)	(10)	(18)	(−18.1)	(71.5)	(14.9)
Scientific measuring instruments.	$17	$47	$154	$217	7.6	21.6	70.8
	(8)	(7)	(12)	(27)	(−10.5)	(16.5)	(7.3)
Optical, surgical, and other instruments.	$12	$450	$486	$948	1.2	47.5	51.2
	(2)	(4)	(7)	(13)	(−2.5)	6.0	16.2
Other manufacturing	$31	$2	$57	$91	34.4	2.2	63.4
	(5)	(2)	(15)	(22)	(1.2)	(10.8)	(37.9)
Nonmanufacturing	$44	$412	$543	$999	4.4	41.2	54.4
	(14)	(10)	(23)	(47)	(−11.8)	(21.3)	(23.9)
Uncoded	$1	$2	$3	$6	12.1	38.5	49.4
	(3)	(2)	(3)	(8)	(−69.8)	19.2)	(9.6)
Total in compilation	$3,091	$6,480	$10,644	$20,215	15.3	32.1	52.7
	(128)	(154)	(310)	(592)	(−8.4)	(14.5)	(16.9)
B. R&D in 1982							
$100 million and over	$2,398	$4,983	$8,149	$15,529	15.4	32.1	52.5
	(4)	(22)	(40)	(66)	(−7.2)	(14.1)	(16.9)
$10 million to $99 million	$525	$1,345	$2,128	$3,999	13.1	33.6	53.2
	(28)	(56)	(100)	(184)	(−8.5)	(15.8)	(17.1)
$1 million to $9 million	$157	$146	$353	$657	23.9	22.3	53.8
	(57)	(61)	(132)	(250)	(−22.0)	(15.2)	(16.3)
Under $1 million	$11	$4	$13	$29	39.2	14.9	45.9
	(39)	(15)	(38)	(92)	(−35.7)	(24.2)	(20.7)
Total in compilation	$3,091	$6,480	$10,644	$20,215	15.3	32.1	52.7
	(128)	(154)	(310)	(592)	(−8.4)	(14.5)	(16.9)

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[1] Using constant eligibility ratio of 0.6329144.
[2] Millions of dollars of R&D (Number of companies).
[3] Percent of total R&D (Percent growth in R&D, 1981-82).

TABLE 3.8—QUALIFIED R&D EXPENDITURES*, BASE, TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, BY NSF INDUSTRY, 1981, FROM COMPUSTAT TAPE, MILLIONS OF DOLLARS

Industry	Base	Qualified R&D	Tentative credit	Credit currently claimed
(1)	(2)	(3)	(4)	(5)
Food	80.6	110.6	7.5	7.4
Textiles and apparel	16.0	19.3	1.0	.0
Lumber, wood, furniture	19.8	21.3	.4	.2
Paper	219.8	259.0	10.0	9.0
Chemicals	804.2	1,012.1	52.0	42.3
Drugs	355.6	428.9	18.3	18.2
Petroleum refining	484.4	680.9	49.2	41.9
Rubber products	146.8	173.9	7.1	6.7
Stone, clay, and glass products	77.3	86.6	2.5	1.7
Ferrous metals	51.5	63.5	3.1	3.1
Nonferrous metals	56.6	62.5	1.6	1.3
Fabricated metal products	66.0	70.2	1.1.	1.0
Nonelectrical machinery	418.0	502.9	23.8	20.0
Computers, office machinery	1,155.8	1,390.5	58.8	56.8
Electrical equipment	449.8	509.1	14.9	14.7

TABLE 3.8—QUALIFIED R&D EXPENDITURES*, BASE, TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, BY NSF INDUSTRY, 1981, FROM COMPUSTAT TAPE, MILLIONS OF DOLLARS—Continued

Industry (1)	Base (2)	Qualified R&D (3)	Tentative credit (4)	Credit currently claimed (5)
Radios, TV's	160.6	189.4	7.5	7.5
Communication equipment	334.8	395.6	15.6	14.4
Electronic components	63.8	86.2	5.7	3.2
Motor vehicles and parts	1,487.2	1,531.0	13.8	8.1
Other transportation	11.8	11.5	.3	.3
Aircraft, missiles	650.8	773.4	32.3	17.9
Scientific measuring instruments	85.9	105.4	5.1	3.9
Optical, surgical, and other instruments	363.7	444.9	20.8	20.7
Other manufacturing	36.5	37.5	.9	.9
Nonmanufacturing	336.8	438.4	27.5	27.0
Uncoded	3.1	4.2	.3	.3
Total in compilation	7,937.5	9,408.8	380.9	329.1

*Using eligibility ratio of 0.6329144.

TABLE 3.9.—QUALIFIED R&D EXPENDITURES AS PERCENT OF BASE AND TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED AS PERCENT OF QUALIFIED EXPENDITURES, BY NSF INDUSTRY, FROM COMPUSTAT TAPE, 1981

Industry	Qualified R&D as percent of base	Percent of qualified R&D	
		Tentative credit	Credit currently claimed
(1)	(2)	(3)	(4)
Food	137.15	6.78	6.69
Textiles and apparel	120.72	4.95	4.56
Lumber, wood, furniture	107.63	1.87	.81
Paper	117.84	3.85	3.48
Chemicals	125.86	5.14	4.18
Drugs	120.60	4.27	4.25
Petroleum refining	140.58	7.22	6.15
Rubber products	118.42	4.06	3.84
Stone, clay, and glass products	112.10	2.88	1.98
Ferrous metals	123.21	4.81	4.81
Nonferrous metals	110.40	2.54	2.01
Fabricated metal products	106.40	1.55	1.37
Nonelectrical machinery	120.31	4.74	3.97
Computers, office machinery	120.30	4.23	4.09
Electrical equipment	113.18	2.93	2.88
Radios, TV's	117.89	3.97	3.96
Communication equipment	118.17	3.94	3.63
Electronic components	135.02	6.59	3.66
Motor vehicles and parts	102.94	.90	.53
Other transportation	97.25	2.27	2.27
Aircraft, missiles	118.83	4.18	2.32
Scientific measuring instruments	132.69	4.85	3.71
Optical, surgical, and other instrument	122.34	4.67	4.66
Other manufacturing	102.55	2.53	2.49
Nonmanufacturing	130.17	6.27	6.16
Uncoded	133.49	7.53	6.71
Total in compilation	118.54	4.05	3.50

TABLE 3.10—R&D QUALIFIED EXPENDITURES,[1] BASE, TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, BY NSF INDUSTRY, 1982, FROM COMPUSTAT TAPE, MILLIONS OF DOLLARS

Industry (1)	Base (2)	Qualified R&D (3)	Tentative credit (4)	Credit currently claimed (5)
Food	180.9	229.1	11.9	10.6
Textiles and apparel	33.3	40.7	2.0	.4
Lumber, wood, furniture	40.8	38.2	.2	.2
Paper	470.4	597.3	32.3	28.8
Chemicals	1,770.8	2,287.9	132.9	46.6
Drugs	768.8	958.7	47.2	46.2
Petroleum refining	1,121.5	1,337.9	57.0	57.0
Rubber products	314.8	359.6	11.6	10.8
Stone, clay, and glass products	161.9	168.6	2.7	2.1
Ferrous metals	112.3	131.7	5.4	.3
Nonferrous metals	117.9	128.9	3.4	.1
Fabricated metal products	135.4	129.1	1.9	1.8
Nonelectrical machinery	901.3	1,007.3	32.3	19.7
Computers, office machinery	2,491.0	3,239.4	186.1	144.4
Electrical equipment	946.0	1,023.2	20.8	18.7
Radios, TV's	343.7	393.7	12.3	10.5
Communication equipment	714.0	868.3	37.7	23.7
Electronic component	145.0	190.5	11.2	6.2
Motor vehicles and parts	3,008.4	3,147.2	44.6	19.7
Other transportation	23.3	20.1	.2	.2
Aircraft, missiles	1,367.5	1,656.9	85.2	34.9
Scientific measuring instruments	186.6	217.1	8.1	5.6
Optical, surgical, and other instruments	791.1	947.7	39.3	25.2
Other manufacturing	73.7	90.7	4.7	4.6
Nonmanufacturing	746.5	998.9	65.9	40.0
Uncoded	5.8	5.8	.3	.1
Total in compilation	16,972.6	20,214.6	857.0	558.5

[1] Using eligibility ratio of 0.6329144.

TABLE 3.11.—QUALIFIED R&D EXPENDITURES AS PERCENT OF BASE AND TENTATIVE CREDIT CURRENTLY CLAIMED AS PERCENT OF QUALIFIED EXPENDITURES, BY NSF INDUSTRY, FROM COMPUSTAT TAPE, 1982

Industry	Qualified R&D as percent of base	Percent of qualified R&D	Tentative credit
			Credit currently claimed
(1)	(2)	(3)	(4)
Food	126.70	5.18	4.65
Textiles and apparel	122.37	4.84	1.06
Lumber, wood, furniture	93.61	0.43	0.43
Paper	126.97	5.41	4.83
Chemicals	129.20	5.81	2.04
Drugs	124.70	4.93	4.82
Petroleum refining	119.30	4.26	4.26
Rubber	114.23	3.21	3.00
Stone, clay, glass	104.12	1.60	1.27
Ferrous metals	117.23	4.07	0.24
Nonferrous metals	109.33	2.67	0.06
Fabricated metal products	95.39	1.51	1.42
Nonelectrical machinery	111.76	3.21	1.95
Computers, office machines	130.05	5.74	4.46
Electrical equipment	108.15	2.04	1.83

TABLE 3.11.—QUALIFIED R&D EXPENDITURES AS PERCENT OF BASE AND TENTATIVE CREDIT CURRENTLY CLAIMED AS PERCENT OF QUALIFIED EXPENDITURES, BY NSF INDUSTRY, FROM COMPUSTAT TAPE, 1982—Continued

Industry	Qualified R&D as percent of base	Percent of qualified R&D	Tentative credit
			Credit currently claimed
(1)	(2)	(3)	(4)
Radios, TV's	114.56	3.12	2.67
Communication equipment	121.61	4.35	2.72
Electronic component	131.40	5.87	3.28
Motor vehicles and parts	104.61	1.42	0.62
Other transportation	86.16	1.16	0.96
Aircraft, missiles	121.16	5.14	2.10
Scientific measuring instruments	116.37	3.71	2.56
Optical, surgical, other instruments	119.79	4.15	2.66
Other manufacturing	123.08	5.14	5.04
Nonmanufacturing	133.81	6.59	4.01
Uncoded	99.38	4.49	2.47
Total	119.10	4.24	2.76

TABLE 3.12.—R&D EXPENDITURES, 1980, 1981, AND 1982, AND SALES, BY AMOUNT OF SALES CATEGORY, FROM COMPUSTAT TAPE

[Dollars in millions]

Category of 1982 net sales	Number of companies	Company R&D expenditures			
		1980	1981	1982	1982 sales
(1)	(2)	(3)	(4)	(5)	(6)
$5 billion and over	52	$16,040	$18,132	$20,007	$892,005
$1 billion to $4 billion	146	6,851	8,070	9,130	341,110
$500 million to $999 million	70	948	1,085	1,210	49,240
$100 million to $499 million	195	970	1,175	1,356	47,644
Under $100 million	129	163	200	237	6,106
Total in compilation	592	24,972	28,661	31,939	1,336,105

TABLE 3.13.—TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, BY AMOUNT-OF-SALES CATEGORY, FROM COMPUSTAT TAPE, 1981, 1982

[Dollars in millions]

Category of 1982 net sales	Tentative credit [1] (TNTCRD)		Credit currently claimed [2] (CRDCCL)		CRDCCL divided by TNTCRD (percent)		1982 CRDCCL as percent of total 1982 CRDCCL	1982 sales as percent of total 1982 sales
	1981	1982	1981	1982	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
$5 billion and over	$215	$491	$195	$326	90.5	66.4	58.4	66.8
$1 billion to $4 billion	124	274	101	174	81.6	63.3	31.1	25.5
$500 million to $999 million	16	36	12	27	78.1	75.0	4.9	3.7
$100 million to $499 million	22	46	18	27	84.0	59.0	4.8	3.6
Under $100 million	4	10	2	4	58.0	45.7	0.8	0.5
Total in compilation	381	857	329	558	86.4	65.2	100.0	100.0

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981 and 1982.

[2] Assuming CRDCCL = TNTCRD if FEDTAX > 0; 0 if FEDTAX < 0 where FEDTAX = Federal income taxes currently payable.

TABLE 3.14.—DISTRIBUTION AND PERCENT INCREASES OF R&D AND TENTATIVE TAX CREDIT, [1] BY AMOUNT-OF SALES CATEGORY, FROM COMPUSTAT TAPE

Category of 1982 net sales	Percent of total in compilation				Percent increases in R&D		Percent increase in tentative credit 1981–82
	R&D		Tentative credit				
	1981	1982	1981	1982	1980–81	1981–82	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$5 billion and over	63.3	62.6	56.5	57.3	13.0	10.3	128.2
$1 billion to $4 billion	28.2	28.6	32.6	32.0	17.8	13.1	120.4
$500 million $999 million	3.8	3.8	4.1	4.2	14.4	11.5	133.8
$100 million to $499 million	4.1	4.2	5.7	5.3	21.1	15.4	110.9
Under $100 million	0.70	0.74	1.1	1.1	22.7	18.7	135.6

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981 and 1982.

TABLE 3.15.—R&D EXPENDITURES, 1980, 1981 AND 1982, BY 1982 EMPLOYMENT CATEGORY, FROM COMPUSTAT TAPE

[Dollars in million]

Number of employees	Number of companies	Company R&D Expenditures			Employment 1982 (thousands)
		1980	1981	1982	
(1)	(2)	(3)	(4)	(5)	(6)
25,000 and up	120	$20,428	$23,295	$25,869	8,645
10,000 to 24,999	92	2,424	2,811	3,117	1,500
5,000 to 9,999	74	699	829	914	538
1,000 to 4,999	197	858	1,041	1,200	527
Under 1,000	100	109	133	157	50
Missing	9	454	551	682	NA
Total in compilation	592	24,972	28,661	31,939	11,260
Total, based to 1980 NSF company funds for R&D		30,476	34,978	38,979	

TABLE 3.16.—TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, BY EMPLOYMENT CATEGORY, FROM COMPUSTAT TAPE, 1981, 1982

[Dollars in millions]

Category of 1982 employment	Tentative credit (TNTCRD)		Credit currently claimed [2] (CRDCCL)		CRDCCL divided by TNTCRD percent		1982 CRDCCL as percent of total 1982 CRDCCL	1982 employment as percent of total 1982 employment
	1981	1982	1981	1982	1981	1982		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
25,000 and over	$293	$670	$259	$458	88.2	68.4	82.0	76.8
10,000 to 24,999	42	85	31	48	73.6	57.0	8.6	13.3
5,000 to 9,999	14	27	13	18	88.8	64.7	3.1	4.8
1,000 to 4,999	19	41	15	27	78.4	66.6	4.9	4.7
Under 1,000	3	6	2	3	76.5	42.9	0.5	0.4
Missing	10	28	10	5	100.0	16.8	0.8	NA
Total in compilation	381	857	329	558	86.4	65.2	100.0	100.0
Total based to 1980 NSF company funds for R&D	465	1,046	402	682				

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981 and 1982.

[2] Assuming CRDCCL=TNTCRD if FEDTAX >0; 0 if FEDTAX <0 where FEDTAX=Federal income taxes currently payable.

TABLE 3.17.—DISTRIBUTION AND PERCENT INCREASES OF R&D AND TENTATIVE TAX CREDIT,[1] BY EMPLOYMENT CATEGORY, FROM COMPUSTAT TAPE

Category of 1982 employment	Percent of total in compilation				Percent increases in R&D		Percent increase in tentative credit 1981–82
	R&D		Tentative credit				
	1981	1982	1981	1982	1980–81	1981–82	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
25,000 and over	81.3	81.0	77.0	78.2	14.0	11.1	128.4
10,000 to 24,999	9.8	9.8	10.9	9.9	16.0	10.8	103.4
5,000 to 9,999	2.9	2.9	3.8	3.2	18.6	10.3	88.8
1,000 to 4,999	3.6	3.8	5.0	4.8	21.4	15.2	115.9
Under 1,000	0.5	0.5	0.7	0.7	22.1	17.8	131.0
Missing	1.9	2.1	2.6	3.3	21.3	23.8	182.6
Total in compilation	100.0	100.0	100.0	100.0	14.8	11.4	125.1

[1] Calculated on assumption of constant eligibility ratio of 0.6329144 for all firms in 1980, 1981 and 1982.

TABLE 3.18.—TENTATIVE CREDIT AND CREDIT CURRENTLY CLAIMED, 1981 AND 1982, USING McGRAW-HILL AGGREGATE ELIGIBILITY RATIOS, BY AMOUNT OF R&D CATEGORY, FROM COMPUSTAT TAPE

[Dollars in millions]

Category of 1982 R&D	Tentative Credit[1] (TNTCRD)		Credit currently claimed[2] (CRDCCL)		GRDCCL divided by TNTCRD (percent)	
	1981	1982	1981	1982	1981	1982
(1)	(2)	(3)	(4)	(5)	(6)	(7)
$100 million and over	$352	$628	$313	$416	88.9	66.3
$10 million to $99 million	110	188	87	114	79.5	60.8
$1 million to $9 million	18	26	15	18	81.7	70.0
Under $1 million	0.8	1.0	0.7	0.8	84.8	77.9
Total in compilation	480	842	415	549	86.5	65.2
Total based to 1980 NSF company R&D	586	1,028	507	670		

[1] Eligibility ratio 0.6226 in 1980, 0.6525 in 1981, and 0.6353 in 1982.

[2] Assuming GRDCCL={TENTCR if FEDTAX>0; 0 if FEDTAX<0 where FEDTAX=Federal income taxes currently payable.

TABLE 3.19.—DISTRIBUTION AND PERCENT INCREASES OF ELIGIBLE R&D AND TENTATIVE CREDIT USING McGRAW-HILL AGGREGATE ELIGIBILITY RATIOS,[1] BY AMOUNT OF R&D CATEGORY, FROM COMPUSTAT TAPE

Category of 1982 R&D	Percent of total in compilation				Percent increases in qualified R&D[2]		Percent increase in tentative credit 1981–82
	Qualified R&D[2]		Tentative credit				
	1981	1982	1981	1982	1980–81	1981–82	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$100 million and over	76.8	76.8	73.2	74.6	19.3	8.6	78.6
$10 million to $99 million	19.6	19.8	22.9	22.3	24.6	9.6	70.6
$1 million to $9 million	3.5	3.3	3.7	3.0	20.3	1.2	43.6
Under $1 million	0.2	0.1	0.2	0.1	7.9	−12.3	14.4
Total in compilation	100.0	100.0	100.0	100.0	20.3	8.5	75.4

[1] Eligibility ratio=.6226 in 1980, .6525 in 1981, .6353 in 1982.

[2] Full-year figures.

TABLE 3.20.—R&D TAX CREDIT SITUATION, 1981 BY 1982 R&D CATEGORY, FROM COMPUSTAT TAPE USING MCGRAW-HILL AGGREGATE ELIGIBLE RATIOS OF 0.6226 AND 0.6525 [1]

Category of 1982 R&D	Firms with—			Total	Firms with—		
	No current credit		Credit		No current credit		Credit
	R&D < Base [2]	R&D > Base but FINTAX < 0 [2]	(CRDCCL = TNTCRD) [2]		R&D < Base [3]	R&D > Base but FINTAX < 0 [3]	(CRDCCL = TNTCRD) [3]
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$100 million and over	$220	$1,717	$12,416	$14,353	1.5	12.0	86.5
	(2)	(5)	(59)	(66)	(−7.0)	(18.6)	(20.0)
$10 million to $99 million	$212	$730	$2,721	$3,663	5.8	19.9	74.3
	(14)	(35)	(135)	(184)	(−9.3)	(28.6)	(27.2)
$1 million to $9 million	$74	$88	$489	$652	11.4	13.6	75.0
	(31)	(37)	(182)	(250)	(−12.8)	(33.7)	(25.2)
Under $1 million	$12	$6	$16	$33	35.5	16.9	47.6
	(35)	(15)	(42)	(92)	(−22.9)	(18.7)	(46.8)
Total in compilation	$518	$2,541	$15,642	$18,701	2.8	13.6	83.6
	(82)	(92)	(418)	(592)	(−9.2)	(21.8)	(21.4)

[1] For 1980 and 1981, respectively.

[2] Millions of dollars of 1981 R&D (number of companies).

[3] Percent of total 1981 R&D (percent growth in R&D, 1980–81).

TABLE 3.21.—REGRESSIONS OF R&D ON LAGGED R&D, CHANGES IN R&D, SALES, SALES CHANGES AND NET INCOME, COMPUSTAT CROSS SECTIONS, 1980, 1981 and 1982

Variable	Regression coefficients and their standard errors: year(t)		
	1980	1981	1982
(1)	(2)	(3)	(4)
Constant	1.051	2.027	0.639
	(0.520)	(0.475)	(0.844)
RD_{t-1}	1.009	1.013	1.029
	(0.010)	(0.005)	(0.007)
$RD_{t-1} - RD_{t-2}$	0.903	0.253	0.628
	(0.053)	(0.034)	(0.068)
$SALES_t$	−0.00181	−0.000169	−0.000846
	(0.00019)	(0.000140)	(0.000246)
$SALES_t - SALES_{t-1}$	0.00389	0.00647	0.00850
	(0.00079)	(0.00102)	(0.00097)
$NETING_t$	0.0208	0.0115	0.0196
	(0.0021)	(0.0020)	(0.0030)
R^2	.995	.996	.998
n	592	592	592

TABLE 3.22.—R&D MINUS BASE AS PERCENT OF PREVIOUS R&D, FOR FIRMS WITH R&D ABOVE AND BELOW BASE, COMPUSTAT TAPE, 1976–82

[Means, standard errors of means, and numbers observations]

Year	Previous year base			Two previous year base		
	RD < Base[1]	RD > Base[1]	Difference	RD < Base[2]	RD > Base[2]	Difference
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1982	−9.3	18.0	27.3	−19.5	33.2	52.6
	(0.8)	(1.3)	(1.5)	(2.2)	(1.8)	(2.8)
	161	429		126	464	
1981	−8.6	23.4	32.0	−21.6	41.0	62.7
	(0.8)	(2.2)	(2.4)	(3.1)	(3.1)	(4.4)
	104	485		91	482	
1980	−9.5	21.7	31.2	−22.2	38.2	60.4
	(0.9)	(2.2)	(2.4)	(4.3)	(2.8)	(5.2)
	97	474		72	484	
1979	−9.4	23.5	32.9	−21.8	38.8	60.5
	(1.0)	(2.3)	(2.5)	(3.7)	(2.8)	(4.7)
	80	476		72	474	
1978	−10.0	18.6	28.6	−21.5	33.7	55.2
	(1.1)	(1.4)	(1.8)	(2.6)	(1.7)	(3.1)
	88	459		79	461	
1977	−9.9	19.5	29.4	−24.8	32.0	56.7
	(1.0)	(2.8)	(2.9)	(3.1)	(3.4)	(4.7)
	92	449		80	448	
1976	−11.2	21.4	32.5	−32.5	33.2	65.7
	(1.0)	(3.8)	(3.9)	(5.6)	(3.9)	(6.8)
	112	419		113	403	

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[1] Calculated as imputed second-half current R&D minus half of R&D of previous year, divided by previous year's R&D.

[2] Calculated as current R&D minus mean of R&D of two previous years, divided by previous year's R&D.

TABLE 4.1.—R&D TAX CREDIT PROJECTIONS, 1981–84, FROM CREDITS REPORTED IN McGRAW-HILL SUPPLEMENTARY R&D SURVEY

[Dollars in millions]

Industry	Reported tax credit[1]			
	1981	1982	1983	1984
(1)	(2)	(3)	(4)	(5)
Chemicals	$82	$189	$202	$266
	(10)	(9)	(9)	(5)
Primary metals	$32	$12	$0	$0
	(3)	(2)	(1)	(1)
Fabricated metal products	$8	$37	$0	$0
	(2)	(3)	(2)	(2)
Machinery	$123	$213	$278	$370
	(14)	(14)	(13)	(12)
Electrical equipment	$105	$89	$102	$107
	(5)	(4)	(4)	(4)
Motor vehicles	$106	$141	$84	$91
	(4)	(4)	(3)	(3)
Aircraft	$12	$3	$3	$4
	(3)	(2)	(2)	(2)
Instruments	$73	$69	$89	$104
	(5)	(5)	(5)	(5)
Other	$143	$129	$172	$183
	(35)	(34)	(25)	(24)
Total	$684	$884	$930	$1,125
	(81)	(77)	(64)	(58)

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[1] Number of firms used for calculations in parentheses. Data are based to industry totals of company-financed R&D for 1980 as reported in NSF (1983), Table B-5.

TABLE 4.2—QUALIFIED R&D EXPENDITURE PROJECTIONS, 1980–84, FROM McGRAW-HILL SUPPLEMENTARY R&D SURVEY

[Dollars in millions]

Industry	Reported qualified expenditures [1]				
	1980	1981	1982	1983	1984
(1)	(2)	(3)	(4)	(5)	(6)
Chemicals	$3,067 (10)	$3,665 (10)	$4,445 (9)	$4,865 (8)	$5,227 (5)
Primary metals	$670 (3)	$858 (3)	$795 (2)	$811 (2)	$0 (1)
Fabricated metal products	$376 (3)	$420 (3)	$536 (3)	$387 (3)	$381 (3)
Machinery	$3,812 (12)	$4,535 (14)	$4,950 (14)	$4,773 (12)	$5,395 (12)
Electrical equipment	$3,246 (5)	$1,831 (5)	$1,995 (5)	$1,037 (4)	$2,153 (4)
Motor vehicle	$2,773 (3)	$2,844 (4)	$3,085 (4)	$3,365 (3)	$3,689 (3)
Aircraft	$2,591 (3)	$2,722 (3)	$2,803 (2)	$1,910 (2)	$2,694 (2)
Instruments	$2,029 (4)	$2,344 (4)	$2,488 (4)	$2,664 (4)	$2,928 (4)
Other	$2,338 (36)	$3,332 (37)	$3,159 (34)	$2,672 (24)	$2,601 (24)
Total	$20,902 (79)	$22,551 (83)	$24,256 (77)	$23,483 (62)	$25,119 (58)

[1] Number of firms used for calculations in parentheses. Data are based to industry totals of company-financed R&D for 1980 as reported in NSF (1983), Table B–5.

TABLE 4.3.—R&D TAX CREDIT PROJECTIONS, 1981–84, FROM QUALIFIED R&D EXPENDITURES REPORTED IN MCGRAW-HILL SUPPLEMENTARY R&D SURVEY

[Dollars in millions]

Industry	Projected tax credit [1]			
	1981	1982	1983	1984
(1)	(2)	(3)	(4)	(5)
Chemicals	$95 (10)	$210 (9)	$238 (8)	$274 (5)
Primary metals	$30 (3)	$0 (2)	$4 (2)	$0 (0)
Fabricated metal products	$13 (3)	$46 (3)	$0.5 (3)	$0 (3)
Machinery	$127 (12)	$195 (12)	$200 (11)	$203 (12)
Electrical equipment	$57 (4)	$124 (4)	$107 (3)	$55 (4)
Motor vehicles	$86 (3)	$54 (3)	$59 (2)	$152 (3)
Aircraft	$21 (3)	$46 (2)	$3 (2)	$57 (2)
Instruments	$50 (4)	$75 (4)	$94 (4)	$107 (4)
Other	$154 (36)	$157 (33)	$104 (23)	$104 (24)
Total	$634 (78)	$907 (72)	$809 (58)	$952 (58)

[1] Number of firms used for calculations in parentheses. Data are based on industry totals of company-financed R&D for 1980 as reported in NSF (1983), Table B–5.

TABLE 4.4.—TOTAL R&D EXPENDITURES FOR 1980 AND 1981 FROM NSF AND PROJECTED TOTALS, FOR 1982–86, FROM R&D SECTION OF MCGRAW-HILL CAPITAL EXPENDITURE SURVEY

[Dollars in millions]

Industry	Total R&D Expenditures [1]						
	1980	1981	1982	1983	1984	1985	1986
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Chemicals (18)	$4,636	$5,325	$6,086	$6,787	$7,349	$7,964	$8,638
Primary metals (13)	728	889	963	911	939	970	1,004
Fabricated metal products (18)	550	638	570	526	544	564	588
Machinery (22)	5,902	6,800	7,361	8,014	8,537	9,106	9,727
Electrical equipment (13)	9,173	10,466	11,878	13,921	15,341	17,015	19,011
Motor vehicles (7)	4,955	4,929	5,001	5,328	5,639	5,972	6,331
Aircraft (6)	9,197	11,702	13,815	18,099	19,036	20,004	21,131
Instruments (8)	3,029	3,685	4,403	4,886	5,558	6,326	7,203
Other (105)	6,313	7,396	7,807	8,423	8,976	9,586	10,256
Total (205)	44,484	51,830	57,884	66,895	71,918	77,547	83,885
Total (percent growth)		16.51	11.68	15.57	7.51	7.83	8.17

[1] Figures for 1981 exactly, and for 1980 with trivial adjustments, from NSF (1983b), Table B–2. Data for 1982 through 1986 calculated from McGraw-Hill survey with number of firms in each industry in parentheses. Expenditures were based to the NSF 1981 industry totals.

For 102 firms with missing observations for 1980, expenditures were imputed by applying industry ratios of 1980 to 1981 NSF R&D, adjusted so that the industry growth rates in the full sample equal the implicit NSF industry growth rates.

TABLE 4.5.—TAX CREDIT AND QUALIFIED EXPENDITURE PROJECTIONS, 1980–85, FROM R&D SECTION OF McGRAW-HILL CAPITAL EXPENDITURE SURVEY

[In millions of dollars]

Industry	Projected tax credit and estimated qualified expenditures [1]					
	1980	1981	1982	1983	1984	1985
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Chemicals		75	167	213	188	180
	(2,723)	(3,127)	(3,574)	(3,986)	(4,316)	(4,677)
Primary metals		13	21	11	6	6
	(366)	(447)	(485)	(458)	(472)	(488)
Fabricated metal products		8	5	6	5	5
	(304)	(353)	(315)	(291)	(301)	(312)
Machinery		81	151	201	167	160
	(3,329)	(3,835)	(4,152)	(4,520)	(4,815)	(5,136)
Electrical equipment		81	202	341	324	325
	(3,606)	(4,114)	(4,670)	(5,473)	(6,031)	(6,689)
Motor vehicles		12	22	54	79	90
	(2,732)	(2,718)	(2,758)	(2,938)	(3,109)	(3,293)
Aircraft		22	105	274	201	132
	(1,592)	(2,026)	(2,391)	(3,133)	(3,295)	(3,470)
Instruments		58	139	155	161	180
	(1,585)	(1,928)	(2,304)	(2,557)	(2,908)	(3,310)
Other		92	162	220	176	160
	(3,267)	(3,828)	(4,040)	(4,359)	(4,646)	(4,961)
Total		442	974	1,477	1,308	1,238
	(19,505)	(22,377)	(24,689)	(27,715)	(29,894)	(32,336)

[1] Based on R&D data for 205 firms used in Table 4.4. Qualified R&D expenditures of firm j in industry k, with industry totals for each year in parentheses, are calculated as: $QUALR\&D_{jk}$ = $R\&D_{jk}$ (ELRAT) ($COFINRAT_k$), where $R\&D_{jk}$ = total domestic R&D expenditures reported in the McGraw-Hill survey by firm j in industry k (imputed for some firms in 1980). ELRAT = 0.6329144 = the assumed constant eligibility ratio, and $COFINRAT_k$ = the ratio of company-financed to total R&D expenditures for 1981 in industry k, as calculated from NSF (1983), Tables B–2 and around B–5.

Industry totals are blown up to correspond to NSF (1983), Table B–5, Company Funds for R&D, for 1981. The same proportionate blowup is then applied in each industry for the other years.

TABLE 4.6.—TENATIVE TAX CREDIT AND QUALIFIED EXPENDITURE PROJECTIONS, 1980–85, APPLYING ANNUAL R&D AGGREGATE ELIGIBILITY RATIOS FROM MCGRAW-HILL SUPPLEMENTARY R&D SURVEY TO R&D EXPENDITURES AND ANTICIPATIONS FROM R&D SECTION OF CAPITAL EXPENDITURES SURVEY

[In millions of dollars]

Industry (1)	Projected tentative tax credit and qualified expenditures [1] 1980 (2)	1981 (3)	1982 (4)	1983 (5)	1984 (6)	1985 (7)
Chemicals		93	164	200	188	186
	(2,679)	(3,225)	(3,588)	(3,951)	(4,340)	(4,704)
Primary metals		16	20	10	6	7
	(360)	(461)	(486)	(454)	(475)	(491)
Fabricated metal products		10	5	6	5	5
	(300)	(364)	(317)	(289)	(303)	(314)
Machinery		109	147	186	166	167
	(3,275)	(3,955)	(4,168)	(4,481)	(4,842)	(5,165)
Electrical equipment		111	198	323	325	334
	(3,548)	(4,243)	(4,688)	(5,425)	(6,065)	(6,725)
Motor vehicles		27	20	46	77	94
	(2,688)	(2,803)	(2,769)	(2,912)	(3,127)	(3,312)
Aircraft		30	103	265	203	137
	(1,566)	(2,089)	(2,401)	(3,106)	(3,314)	(3,489)
Instruments		70	137	146	162	185
	(1,559)	(1,988)	(2,313)	(2,535)	(2,925)	(3,329)
Other		119	159	206	175	167
	(3,215)	(3,948)	(4,056)	(4,321)	(4,672)	(4,989)
Total		586	954	1,388	1,307	1,281
	(19,191)	(23,077)	(24,786)	(27,474)	(30,064)	(32,520)

[1] Sources similar to Table 4.5 except that $QUALR\&D_{jk} = R\&D_{jk}$ $(ELRAT_t)$ $(COFINRAT_k)$, where $ELRAT_t$ = the ratio for the year t of the aggregate of qualified R&D expenditures to total company-financed R&D for the year t as reported in the McGraw-Hill Supplementary R&D Survey. $ELRAT_{80} = 0.6226$; $ELRAT_{81} = 0.6525$; $ELRAT_{82} = 0.6353$; $ELRAT_{80} = 0.6273$; $ELRAT_{84} = ELRAT_{85} = 0.6364$.

TABLE 4.7.—CREDIT WITHOUT LIMITATIONS CALCULATED FROM AGGREGATES

[In millions of dollars]

Year	Company-financed R&D	Qualifying expenditures eligibility ratio		Credit without limitations eligibility ratio	
		Constant [1]	Variable[2]	Constant [1]	Variable[2]
(1)	(2)	(3)	(4)	(5)	(6)
1980					
1980	[3] 30,476	19,289	18,975	—	—
1981	[3] 35,362	22,381	23,073	—	—
1981–II	[4] 18,378	11,606	11,965	491	620
1982	[5] 39,360	24,911	25,005	1,019	995
1983	[5] 43,265	27,611	27,140	1,354	1,197
1984	[5] 49,009	31,018	31,189	1,513	1,529

[1] 0.6329144.

[2] From McGraw-Hill Supplementary R&D Survey: 0.6226, 0.6525, 0.6353, 0.6273 and 0.6364 for 1980, 1981, 1982, 1983 and 1984, respectively.

[3] From NSF (1983b), Table B-5.

[4] Calculated as R&D81–II equals $RD81/\{(RD80/RD81)^{.5} + 1\}$.

[5] From NSF (1983a), industry funds for research and development by source, multiplied by 0.897 from NSF (1983).

TABLE 4.8.—THE TAX CREDIT AND COMPONENTS OF R&D

$[\Delta ARD = b_0 + b_1\ TC{:}\quad \Delta RDQ = b_{0_q} + b_{1_q}\ TC;\quad \Delta RDNQ = b_{0_n} + b_{1_n}\ TC]$

	1981			1982		
	ΔRD (total)	ΔRDQ (qualified)	ΔRDNQ (non-qualified)	ΔRD (total)	ΔRDQ (qualified)	ΔRDNQ (non-qualified)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
(Regression Coefficients and Standard Errors)						
Constant	0.062	0.081	−0.015	−0.112	−0.033	0.248
	(0.030)	(0.042)	(0.050)	(0.027)	(0.022)	(0.033)
TC	3.728	5.051	−1.124	3.394	3.467	−0.109
	(0.823)	(1.123)	(1.351)	(0.539)	(0.420)	(0.631)
R^2	.218	.234	.000	.369	.512	.000
n	71	64	64	67	65	65
(Means and Standard Errors of Means)						
Dependent variable	0.158	0.213	−0.044	0.102	0.086	0.021
	(0.024)	(0.034)	(0.036)	(0.026)	(0.023)	(0.024)
TC	0.026	0.026	0.026	0.033	0.034	0.034
	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)

N.B. RD = total company-funded domestic R&D expenditures.
RDQ = Qualified R&D expenditures.
RDNQ = RD—RDQ = nonqualified R&D expenditures.
TC = tax credit.
All variables are divided by lagged RD.

TABLE 5.1.—SUMMARY: VARIED ESTIMATES OF TAX CREDITS, 1981,1982

[In millions of dollars]

Sources	Tentative credit		Credit currently claimed	
	1981	1982	1981	1982
(1)	(2)	(3)	(4)	(5)
OTA, 80 percent tabulation	408		232	
OTA blown up to 100 percent	511		290	
Compustat:				
Constant eligibility ratio	465	1,046	402	682
Variable eligibility ratios	586	1,028	507	670
McGraw-Hill, tax credit question	684	884		
McGraw-Hill, from qualified R&D	634	907		
McGraw-Hill, from main survey:				
Constant eligibility ratio	442	974		
Variable eligibility ratios	586	954		
Aggregates, ignoring limitations:				
Constant eligibility ratio:				
From Compustat	451	989		
From NSF	491	1,019		
Variable eligibility ratios:				
Compustat	579	960		
From NSF	620	995		

APPENDIX A. SHORT-TERM AND LONG-TERM EFFECTS OF R&D CHANGES ON INCREMENTAL TAX CREDIT

Our analysis of effective rates is all in terms of marginal changes in qualified R&D expenditures, so that we examine the effect on the credit of changes in the R&D growth pattern of a firm. It is the credit received for these marginal expenditures which can be expected to have the greatest impact on whether they are made, rather than total credit earned.

An example may serve to clarify this, as well as explain how firms can receive substantial tax credits despite an effective marginal rate close to zero. For ease of exposition, we will assume a permanent 25 percent incremental credit with a three-year moving average base.

Consider a firm whose qualified R&D expenditures are growing at 10 percent per year, starting at $1 million in year 1 of our example. Its base for that year would be the average of qualified expenditures for the three previous years, i.e. ⅓ (1,000,000/1.1 + 1,000,000/(1.1)^2 + 1,000,000/(1.1)^3) or $828,951. The increase in qualified R&D over base would be 1,000,000 − 828,951 = $171,049, and its credit would be 25 percent of that, or $42,762. The other entries in the first section of the table are calculated analogously.

Suppose now that this firm contemplates undertaking an additional research project in year 1 costing $60,000 (all qualified), and having no effect on spending in subsequent years. In year 1, its expenditure will be $60,000 higher, its increase in expenditure over base will be $60,000 greater, and its credit will accordingly be higher by 25 percent of that amount, or $15,000. The bases for years 2, 3, and 4, however, include expenditures of year 1; since the base is a three-year average, it will be higher in each of those years by ⅓ (60,000) = $20,000, so that the increases in eligible R&D each year will be lower by $20,000 each year, leading to a reduction in credit each year of 25 percent of that $20,000, i.e. $5,000, as shown in the second section of Table A.1. The net effect on the credit earned of this $60,000 increase in R&D is then to increase it by $15,000 in year 1 and reduce it by $5,000 in each of the following three years. At a 10 percent discount rate, the present value of this income stream is only $855.25, for an effective marginal rate of credit of only 1.425 percent.

Note that this does not mean that firms receive only miniscule credits for R&D expenditures, as the table clearly shows. What it does mean is that the incentive to undertake additional projects can be quite small.

A similar analysis of a permanent increase of $60,000 over the previously scheduled rates of annual expenditure shows one-time credit gains of $15,000, $10,000, and $5,000 in the first three years, with no effect in years after the third. (However, if the firm eventually returned to its original plan for R&D, there would follow losses in these same amounts in the first three years after the return, assuming that the credits in those years would otherwise have been at least $15,000 in the first year, $10,000 in the second year and $5,000 in the third year.)

A greater incentive exists for beginning a new research project or division which grows at the same rate as the rest of the company's R&D; in this case, again assuming $60,000 in year 1 and 10 percent annual growth which now applies to the $60,000 as well as the original R&D, the additonal credits would be $15,000 in year 1, $11,500 in year 2, $7,650 in year 3, and $3,415 in year 4, when the project would be spending $79,860. The additional credit thereafter would grow at 10 percent annually, so that the constant percentage saving of (3,415/79,860) = 4.28 percent of cost would continue forever.

A final possibility is that the company would decide to raise its rate of growth of R&D permanently, say from 10 percent to 11 percent annually. (A priori this is an unlikely outcome, since one-time changes such as this in cost of R&D are usually expected to shift levels, rather than rates of growth, but we include it for the sake of completeness.) Assuming that year 1 is 11 percent higher than year 0, rather than 10 percent, and that the 11 percent growth rate continues thereafter, we get the last section of our table. In this case the long-run effect on R&D cost can be inferred from looking at year 4, when the credit is $63,975.78 on total R&D expenditure of $1,380,064, or 4.64 percent.

TABLE A.1.—EFFECTS OF FIRM DECISIONS ON INCREMENTAL TAX CREDIT

	Year 1	Year 2	Year 3	Year 4
1. OriginaL:				
R&D	1,000,000	1,100,000	1,210,000	1,331,000
Base	828,951	911,846	1,003,030	1,103,333
R&D—base	171,049	188,154	206,970	227,667
Credit	42,762	47,039	51,742	56,917
2. Change in year 1 only:				
R&D	1,060,000	1,100,000	1,210,000	1,331,000
Base	828,951	931,846	1,023,030	1,123,333
R&D—base	231,049	168,154	186,970	207,667
Credit	57,762	42,039	46,742	51,917
Change in credit	15,000	−5,000	−5,000	−5,000
3. Permanent $60,000 increase:				
R&D	1,060,000	1,160,000	1,270,000	1,391,000
Base	828,951	931,846	1,043,030	1,163,333
R&D—base	231,049	228,154	226,970	227,667
Credit	57,762	57,039	56,742	56,917
Change in credit	15,000	10,000	5,000	0
4. Growing $60,000 increase (new division):				
R&D	1,060,000	1,166,000	1,282,600	1,410,860
Base	828,951	931,846	1,045,030	1,169,533
R&D—base	231,049	234,154	237,570	241,327
Credit	57,762	59,539	59,392	60,332
Change in credit	15,000	11,500	7,650	3,415
5. Change Growth Rate from 10 percent to 11 percent:				
R&D	1,009,091	1,120,091	1,243,301	1,380,064
Base	828,951	914,876	1,012,758	1,124,161
R&D—base	180,140	205,215	230,543	255,903
Credit	45,035	51,304	57,636	63,976
Change in credit	2,273	4,265	5,893	7,059

Appendix B. Mathematical Exposition

(1.1) Let RD_{it} = R&D expenditures of the i-th firm in the year t

(1.2) Let RQ_{it} = R&D expenditures considered qualifying for the incremental tax

(1.3) $E_{it} = RQ_{it}/RD_{it}$ = the eligibility ratio

(1.4) Let B_{it} = the base for calculation of the incremental credit

(1.5) Let AB_{it} = the adjusted base

(1.6) Let TC_{it} = the tentative credit, ignoring tax liabilities

(1.7) Let TL_{it} = tax liability without the tax credit

(1.8) Let AC_{it} = the actual credit

(1.9) Let k_{it} = the effective marginal rate of tax credit of the i-th firm in the year t

(1.10) Let r_{it} [or $(1+r_{it})^{-1}$] = the rate of discount

Hereafter omitting firm subscripts to simplify the notation,

(1.11) $B_t = .5RQ_{t-1}$ $\quad t = 1981$

(1.12) $B_t = .5(RQ_{t-1} + RQ_{t-2})$ $\quad t = 1982$

(1.13) $B_t = \frac{1}{3}(RQ_{t-1} + RQ_{t-2} + RQ_{t-3})$ $\quad t = 1983, 1984, 1985$

(1.14) Let RQS = Qualifying R&D expenditure subject to the credit

(1.15) $RQS_t = RQ_t$ after June 30 $\quad t = 1981$

(1.16) $RQS_t = RQ_t$ $\quad t = 1982 \ldots 1985$

(1.17) $AB_t = \text{Max}(B_t, .5RQS_t)$

(1.18) $TC_t = \text{Max}[.25(RQS_t - AB_t), 0]$

(1.19) $AC_t = \text{Max}(0, \text{Min}(TC_t, TL_t))$

On the assumption that the credit is not limited by lack of tax liabilities and that it expires at the end of 1985, that is,

(1.20) $AC_t = TC_t$, $t = 1981$ to 1985, and $TC_t = 0$ for $t > 1985$, and writing

(1.21) $r_{it} = r$ for all i, t,

(1.22) $$k_{1981} = .25\ [Y_0 - .5Y_1(1+r)^{-1} - \frac{1}{3} Y_2(1+r)^{-2} - \frac{1}{3} Y_3\ (1+r)^{-3}]$$

(1.23) $$k_{1982} = .25\ [Y_0 - \frac{1}{3} \sum_{j=1}^{3} Y_j\ (1+r)^{-j}]$$

(1.24) $$k_{1983} = .25\ [Y_0 - \frac{Y_1}{3}(1+r)^{-1} - \frac{Y_2}{3}\ (1+r)^{-2}]$$

(1.25) $$k_{1984} = .25\ [Y_0 - \frac{Y_1}{3}\ (1+r)^{-1}]$$

(1.26) $$k_{1985} = .25Y_0$$

(1.27) where $Y_j = 1$ when $B_{t+j} \leq RQS_{t+j} < 2B_{t+j}$ $\quad j = 0,\ldots 3$

(1.28) (1.29) $$\left.\begin{array}{l} Y_j = .5 \\ Y_j = 0 \end{array}\right\} \text{when} \quad 2B_{t+j} \leq RQS_{t+j} \quad \left\{\begin{array}{l} j = 0 \\ j = 1,2,3 \end{array}\right.$$

(1.30) and $Y_j = 0$ when $B_{t+j} > RQS_{t+j}$ $\quad j = 0..,3$.

Where the credit is limited by lack of tax liabilities, that is, $TC_t > TL_t$ (or $AC_t < TC_t$), the situation becomes more complicated, depending first on the availability of tax liabilities in prior years against which the credit may be carried back and second, if carry-back is not possible, the number of years that the credit is carried forward.

For firms where

(1.31) $$B_{t+j} < RQS_{t+k} < 2\,B_{t+j} \qquad j = 0,\ldots 3$$

effects on the amount of the tax credit of interacting growth rates of RQ and increasing mean lags of the base may be described as follows.

(1.32) Let $g_1 = (RQ_{81} - RQ_{80})/RQ_{80}$

(1.33) $g_1^* = (RQS_{81} - .5RQ_{80})/.5\,RQ_{80}$

(1.34) $g_2 = (RQ_{82} - RQ_{81})/RQ_{81}$

(1.35) $g_3 = (RQ_{83} - RQ_{82})/RQ_{82}$

Qualifying expenditures, RQ, the base, B, and the amount of the tentative credit, TC, as ratios of 1980 qualifying expenditure may then be tabulated:

		1980	1981	1982	1983
(1.36)	RQ	1	$.5\,(1+g_1^*)$	$(1+g_1)(1+g_2)$	$(1+g_1)(1+g_2)(1+g_3)$
(1.37)	B	-	$.5$	$1 + \frac{g_1}{2}$	$1 + \frac{2g_1 + g_2 + g_1g_2}{3}$
(1.38)	TC	-	$.125\,g_1^*$	$.25(\frac{g_1}{2} + g_2 + g_1g_2)$	$.25\,[\frac{g_1}{3} + \frac{2}{3}(g_2+g_1g_2)$ $+ g_3 + g_1g_3 + g_2g_3 + g_1g_2g_3]$

For constant continuous rates of growth

(1.39) $$g_1^* = \frac{(1+g_1)^{1.5}}{.5\,[1 + (1+g_1)^{.5}]} - 1$$

(1.40) and then, for $g_1 \equiv g_2 \equiv g_3 \equiv g_1$

(1.41)	TC	-	$.125\overset{*}{g}$	$.25(\frac{3g}{2} + g^2)$	$.25(2g + \frac{8g^2}{3} + g^3)$

The path and rates of change of the tentative credit for illustrative values of g may then be tabulated:

g	TC/RQ_{80}			$\frac{TC_{82}}{TC_{81}} - 1$	$\frac{TC_{83}}{TC_{82}} - 1$
	1981	1982	1983	Percent Changes	
.05	.00785	.01938	.02670	+ 147%	+ 37.8%
.1	.01578	.04000	.05692	+ 154	+ 42.3
.15	.02377	.06188	.09084	+ 160	+ 46.8
.2	.03183	.08500	.12867	+ 167	+ 51.4

Finally, it is well to note the interaction, in both qualifying expenditures and base, of real R&D, inflation and the eligibility ratio. We may obviously write

$$RQ = \frac{RD}{P} \cdot P \cdot \frac{RQ}{RD} \quad . \tag{1.42}$$

The relative change in RQ may then be written as

$$d \ln RQ = d \ln \frac{RD}{P} + d \ln P + d \ln \frac{RQ}{RD} \quad . \tag{1.43}$$

It is clear that TQ, the base, and hence the credit itself are affected in precisely the same manner by relative changes in real R&D, prices of R&D, and the eligibility ratio. The analysis we have provided above, regarding qualifying R&D expenditures, applies equally to movements in such expenditures, whether as a consequence of real changes in R&D, price changes or changes in eligibility ratios.

APPENDIX C. DEFINITIONS OF UNDERLYING DATA

Data on R&D expenditures which we have utilized have been variously collected by the Census Bureau for the National Science Foundation, by the Office of Tax Analysis from the Internal Revenue Service, by Standard and Poor's Compustat Services from publicly disclosed company 10-K reports to the Securities and Exchange Commission, and by the McGraw-Hill Publishing Company Department of Economics.

Census Bureau—National Science Foundation Data.—The National Science Foundation (NSF), using Census Bureau data, does by far the most extensive analysis of R&D expenditures. NSF focuses primarily on domestic R&D expenditures: "Basic and applied research in the sciences and engineering and the design and development of prototypes and processes. This definition excludes quality control, routine product testing, market research, sales promotion, sales service, research in social sciences or psychology, and other nontechnological activities or technical services." [5]

R&D expenditures are further classified by source of funds. Total domestic company performed R&D reported to NSF is the sum of company-funded R&D ($35.4 billion in 1981) and federally-funded R&D ($16.5 billion). Company-funded R&D includes "company-sponsored research and development performed within the company. Does not include company-financed research and development contracted to outside organizations, universities and colleges, and nonprofit organizations." [6] Federally-funded R&D is "work done by the company on federal R&D contracts or subcontracts and R&D portions of procurement contracts and subcontracts." [7] In this study we have used both total and company-funded R&D to scale up our survey responses.

Securities and Exchange Commission—Compustat—Business Week Data.—Companies with sales of $35 million or more and R&D expenses of at least $1 million or at least one percent of sales are required to report R&D expenditures to the SEC in their 10-K reports. While these reports include only company-sponsored research, they may include foreign as well as domestic R&D performed by the company. NSF reports that $2,721 million of R&D in 1979 [8] (approximately 10.6 percent of domestic company-funded R&D) was done by foreign affiliates of U.S. companies. The 10-K R&D figures are collected by Standard and Poor's Compustat Services, which are in turn reported by Business Week in their annual "R&D Scoreboard." Thus, from Business Week and from Compustat we have obtained total (domestic and foreign) company-funded R&D expenditures.

Internal Revenue Service—Office of Tax Analysis Data.—In order to receive the incremental credit for R&D, firms must report "qualified" expenses for the current year and for the corresponding base period. Qualified R&D expenses are usually substantially smaller than company-funded domestic R&D because there are many types of R&D to which the credit does not apply. Qualified R&D expenditures includes wages and salaries, costs of supplies, remuneration to others for use of machinery, 65 percent of contract research, and 65 percent of basic research done for firms by universities and other tax exempt institutions. Qualified expenditures do not include expenditures for capital goods used in performing research, nor do they include expenditures for research in the social sciences or humanities. The Office of Tax Analysis of the Treasury Department has compiled data from a large sample of 1981 business returns on the incremental tax credit Form 6765. From OTA we have been able to obtain industry aggregates of qualified R&D expenses in 1980 and 1981.

McGraw-Hill Survey Data.—On the main questionnaire of the 1983 McGraw-Hill survey firms are asked: "What was the cost of all R&D performed by your company in the U.S. in 1981 and 1982?" Thus, from the main questionnaire we have obtained total domestic federally-funded and company-funded R&D expenditures. From our special supplementary questionnaire included in the McGraw-Hill survey we have obtained direct responses from a small number of firms separately on 10-K R&D, domestic company-funded R&D, domestic federally-funded R&D, and R&D qualified for the tax credit. All of the McGraw-Hill responses were made available to us by code number to preserve company anonymity.

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[5] NSF (1981), p. 2.

[6] Ibid., p. 2.

[7] Ibid., p. 2.

[8] NSF (1981), Table B-12, p. 22.

APPENDIX D

Form 6765
Department of the Treasury
Internal Revenue Service

Credit for Increasing Research Activities

▶ Attach to your tax return ▶ See separate Instructions

OMB No. 1545-0619

1981

Name	Identifying number as shown on page 1 of your tax return

If you are a partnership, estate, trust, or subchapter S corporation that shares the credit among your partners, beneficiaries, or shareholders, complete only lines 1 through 12.

If you are an individual partner, beneficiary, or shareholder who receives a credit from a partnership, estate, trust, or subchapter S corporation, and you have no other credit for increasing research activities, skip lines 1 through 8 and enter your share of the credit on line 9, 10, 11. Complete the rest of the form as it applies. If you are a member of a group of trades or businesses under common control (whether or not incorporated), or an estate or trust that shares the credit between yourself and your beneficiaries, see the instructions for lines 6 and 12 before completing the form.

If you have made an acquisition or disposition of a major portion of your trade or business during the tax year or preceding tax year, please see instructions for Special Rules before completing the form.

Part I Allowable Credit

1 Qualified research expenses paid or incurred after June 30, 1981, during this tax year (see instructions for line 1):		
a Wages for qualified services	1a	✓
b Cost of supplies used in conducting qualified research	1b	✓
c Rental or lease costs for personal property used in conducting qualified research	1c	✓
d 65% of contract research expenses paid or incurred for qualified research. (Do not enter corporate expenses reported in line 1e.)	1d	✓
e Corporations—Enter 65% of amounts paid or incurred to qualified organizations for basic research	1e	✓
f Total—Add lines 1a through 1e	1f	✓
2 Base period research expenses (see instructions for line 2):		
a Wages for qualified services	2a	✓
b Cost of supplies used in conducting qualified research	2b	✓
c Rental or lease costs for personal property used in conducting qualified research	2c	✓
d 65% of contract research expenses paid or incurred for qualified research. (Do not enter corporate expenses reported in line 2e.)	2d	✓
e Corporations—Enter 65% of amounts paid or incurred to qualified organizations for basic research	2e	✓
f Total—Add lines 2a through 2e	2f	✓
g Line 2f times adjustment factor (see instructions for line 2g)	2g	✓
3 Subtract line 2g from line 1f	3	
4 Limitation—Enter 50% of line 1f	4	
5 Enter the smaller of line 3 or line 4	5	
6 Tentative credit—Enter 25% of line 5	6	✓
7 Carryback of unused credit(s)	7	
8 Allowable credit—Add lines 6 and 7	8	✓
9 Credit from a partnership (including any carryback of unused credit(s))	9	
10 Credit from an estate or trust (including any carryback of unused credit(s))	10	
11 Credit from a subchapter S corporation (including any carryback of unused credit(s))	11	
12 Total credit—Add lines 8, 9, 10, and 11	12	

Part II Tax Liability Limitation

13 a Individuals—Enter amount from Form 1040, line 37 b Estates and trusts—Enter amount from Form 1041, line 26 c Corporations (1120 filers)—Enter amount from Schedule J (Form 1120), line 3 d Other organizations (see instructions for line 13d)	13	
14 Enter total allowed credits from your return (see instructions)	14	
15 Tax on lump-sum distributions from Form 4972 or Form 5544	15	
16 Section 72(m)(5) penalty tax (individuals only)	16	
17 Total—Add lines 14, 15, and 16	17	
18 Limitation—Subtract line 17 from line 13. (Individuals see Part IV on page 2.)	18	

Part III Allowed Credit for Corporations, Estates, and Trusts

19 Allowed credit—Enter the smaller of line 18, Part II, or line 12, Part I. (Enter here and on the appropriate line of your tax return as explained in the instructions for line 19.)	19	✓

For Paperwork Reduction Act Notice, see page 2.

Form 6765 **Page 2**

Part IV Allowed Credit for Individuals

20 a Allowed credit for line 8, Part I—Enter the smallest of line 8, Part I; line 18, Part II; or the amount from the formula in the instructions for line 20	20a	
b Allowed credit for line 9, Part I—Enter the smallest of line 9, Part I; line 18, Part II; or the amount from the formula in the instructions for line 20	20b	
c Allowed credit for line 10, Part I—Enter the smallest of line 10, Part I; line 18, Part II; or the amount from the formula in the instructions for line 20	20c	
d Allowed credit for line 11, Part I—Enter the smallest of line 11, Part I; line 18, Part II; or the amount from the formula in the instructions for line 20	20d	
21 Total credit allowed for individuals—Add lines 20a, 20b, 20c, and 20d. Do not enter more than line 18, Part II. (Enter here and include the credit in the total for line 46, page 2, Form 1040.) .	21	.

Paperwork Reduction Act Notice.—The Paperwork Reduction Act of 1980 says we must tell you why we are collecting this information, how we will use it, and whether you have to give it to us. We ask for the information to carry out the Internal Revenue laws of the United States. We need it to ensure that you are complying with these laws and so that we can figure and collect the correct amount of tax. You are required to give us this information.

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APPENDIX E

No. G_______________

McGRAW-HILL PUBLICATIONS COMPANY
Department of Economics
1221 Avenue of the Americas
New York, NY 10020

BUSINESS' PLANS FOR NEW PLANTS AND EQUIPMENT 1983-86

(All questions apply to U.S. only)

CAPITAL SPENDING

In your answers to the following questions, please include all purchases charged to capital accounts, whether for replacement, expansion, or other purposes. Please include the value of new plants and equipment leased to others, but not the value of new plants and equipment leased from others. Also, please do not include acquisitions.

1. How much did your company invest in new plants and equipment in the U.S. in 1982, and how much does it plan to invest (inflation included) in 1983-86? (If answers omit 000s or 000,000s, note: ____________.)

1982	1983	1984	1985	1986
$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]	$ [illegible]

Question 2 concerns the individual years 1982 and 1983, and the combined years 1984-86. Answers for 1984-86 should be annual averages for those years. We realize that providing information for 1984-86 may not be easy, but we would appreciate having your best guesses.

	1982	1983	1984-86 avg.
2. Of the total amount invested in new plants and equipment, what percent was (will be) for:			
Buildings	[illegible] %	[illegible] %	[illegible] %
Machinery & Equipment	[illegible] %	[illegible] %	[illegible] %
Motor Vehicles	[illegible] %	[illegible] %	[illegible] %
	100%	100%	100%
Of the total invested, what percent was (will be) for expansion?	%	%	%
Of the total invested, what percent was (will be) for employee safety & health?	%	%	%
Of the total invested, what percent was (will be) for:			
Air Pollution Control	%	%	%
Water Pollution Control	%	%	%
Solid Waste Pollution Control	%	%	%
3. If your firm is in manufacturing or mining: How much did (will) your company's capacity, measured in terms of physical volume, increase (decrease)? Please show yearend vs. yearend changes (yearend 1983 to yearend 1986 for the 1984-86 column).	%	%	%
At the end of 1982, at what rate of capacity was your company operating?	%	▨	▨
What is your firm's preferred rate of operation?	%	▨	▨

ESEARCH AND DEVELOPMENT (R&D)

1. What was the cost of all R&D performed by your company in the U.S. in 1981 and 1982? (If answers omit 000s or 000,000s, note:________.)

   a. What were your R&D capital expenditures in the U.S.?

1981	1982
[illegible] $ [illegible]	[illegible] $ [illegible]
$ [illegible]	$ [illegible]

2. What percent of R&D spending went (will go) for:

		1982	1983	1984-86 av.
New Products	RCPC382, RCPC383, RCPC3846	%	%	%
New Processes	RDPC382, RDPC383, RDPC3846	%	%	%
Improving Existing Products	RCEP382, RCEP383, RCEP3846	%	%	%
		100%	100%	100%

	1982-83	1983-86
3. By what percent do you think your company's total R&D spending will increase (decrease) between 1982-83 and 1983-86?	[illegible] %	[illegible] %
4. Roughly what percent of your 1986 sales do you think will be in new products (products you did not produce in 1982 or products significantly different than in 1982)?		RDNT8386 %

SALES AND PRICES

For 1983-86 percent change, please state total percent change, not annual average change.

1. What were your company's sales, including exports, in 1982? (If answers omit 000s or 000,000s, note:__________.)	1982 $ SL 8382	
2. By what percent do you think your sales will increase (decrease) between 1982-83 and 1983-86?	SLIN8283 %	SLIN8386 %
3. By what percent do you think the prices of goods and services your company sells will increase (decrease) between 1982-1983 and 1983-86?	PCHS8283 %	PCHS8386 %
4. By what percent do you expect the prices of plant and equipment your company buys to increase (decrease) between 1982-83 and 1983-86?	PCHE8283 %	PCHE8386 %

AME________________________ TITLE________________________

OMPANY________________________

DDRESS________________________

ALL YOUR ANSWERS WILL BE HELD STRICTLY CONFIDENTIAL
(Please return by March 31)

McGRAW-HILL PUBLICATIONS COMPANY
Department of Economics
1221 Avenue of the Americas
New York, NY 10020

SUPPLEMENTARY RESEARCH AND DEVELOPMENT SURVEY

(All questions apply to U.S. only)

Dear McGraw-Hill Survey Cooperator:

In addition to our regular spring business plans survey, which you should have received recently, McGraw-Hill is conducting a special survey this year to analyze the impact of recent tax changes on R&D. If you have the time and data to fill out this special set of R&D questions by April 15, it would be much appreciated. Please do not let this questionnaire interfere with your returning the regular survey questionnaire to us by March 31. Answers on this form for 1983 and 1984 should, of course, be based on current anticipations.

1. What were (will be) total R&D expenditures reported to the Securities and Exchange Commision in your company's 10-K report?

1980 $________ 1981 $________ 1982 $________ 1983 $________ 1984 $________

R10K80 R10K81 R10K82 R10K83 R10K84

2. What were (will be) company-financed and federally-financed R&D expenditures reported t the Census Bureau (Form MA-121)?

RD-1

Company-financed:

1980 $________ 1981 $________ 1982 $________ 1983 $________ 1984 $________

RCENC80 RCENC81 RCENC82 RCENC83 RCENC84

Federally-financed:

1980 $________ 1981 $________ 1982 $________ 1983 $________ 1984 $________

RCENF80 RCENF81 RCENF82 RCENF83 RCENF84

3. What were (will be) the amounts of qualified research expenses used in base period calculations for your company's incremental R&D tax credit, as reported on IRS form #6765? (Please enter annual or annualized amounts; for the 1981 credit only half-year base periods were used.)

1980 $________ 1981 $________ 1982 $________ 1983 $________ 1984 $________

[illegible] [illegible] [illegible] [illegible] [illegible]

4. What were (will be) the amount of incremental R&D tax credits claimed on IRS form #6765

1981 $________ 1982 $________ 1983 $________ 1984 $________

[illegible] [illegible] [illegible] R-C84

Please indicate here if answers omit 000s or 000,000s: ________

NAME________________ TITLE________________

COMPANY________________

ADDRESS________________

(Please return by April 15)

REFERENCES

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National Science Foundation. Research and Development in Industry Funds, 1979, Scientists and Engineers, January 1980, detailed statistical tables NSF 81-234 [NSF (1981)].

———. Science Resources Studies Highlights, NSF 83-316, July 22, 1983 [NSF (1983a)].

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STATEMENT TO THE HOUSE WAYS AND MEANS COMMITTEE ON THE EFFECTS OF THE RESEARCH AND DEVELOPMENT TAX CREDIT

STATEMENT OF EDWIN MANSFIELD, PROFESSOR OF ECONOMICS, UNIVERSITY OF PENNSYLVANIA

I am honored to have been invited to testify before this committee. As you know, Congress passed an R and D tax credit as part of the Economic Recovery Tax Act of 1981. This measure, which in the absence of Congressional action will expire at the end of 1985, was regarded as a major experiment to determine whether such a credit would work well enough to be made permanent. To evaluate the credit's effectiveness, one must estimate the extent to which it has increased company-financed R and D expenditures, this being its stated purpose. In this testimony, I shall summarize very briefly what seems to be the first empirical study of this topic. Also, detailed evidence is presented for Sweden and Canada, both of which have had direct R and D tax incentives for one or more decades. These studies of all three countries have been financed by the National Science Foundation.

The U.S. R and D Tax Credit

For many years, economists have pointed out that a market economy is likely to underinvest in civilian technology because of the difficulties firms encounter in appropriating the benefits that society receives from new technology. The more basic the R and D project and the more competitive the market, the less appropriable the benefits are likely to be. In addition, since economists cannot rely solely on a priori theorizing to tell them whether there is an underinvestment in R and D in the private sector (and if so, where it is most severe), attention has been focused on empirical studies of the social and private returns from R and D of various sorts.

Practically all of these studies indicate that the average and marginal social rates of return from industrial R and D tend to be very high, often 30 percent or more. Although these studies suffer from a variety of limitations, many economists have concluded that the United States may be underinvesting in civilian technology.[1]

Congress, responding to evidence of this sort (as well as to other considerations), provided in 1981 for a 25 percent tax credit for R and D expenditures in excess of the average of a firm's R and D expenditures in a base period (generally the previous three taxable years). Expenditures qualifying for this incremental tax credit are "in-house" expenditures for R and D wages, supplies, and the use of equipment; 65 percent of the amount paid for contract research; and 65 percent of corporate grants to universities and certain scientific research organizations for basic research. Unused R and D tax credits can be carried forward up to fifteen years. According to the Treasury, the revenue loss due to the tax credit will be about $1 billion per year. During 1981, it was estimated to be about $0.6 billion because the credit was in effect for only half of the year.[2]

On the basis of the usual statistical techniques, it is very difficult to estimate the effects of the tax credit, due to the very short period of time it has been in existence and the fact (discussed at length below) that the reported figures on R and D spending are affected by changes in what is included as "research and development." Since the introduction of the tax credit, reported company-financed R and D expenditures have risen at relatively high levels. However, both government and private analysts point out that little can be deduced from this fact alone since the boom in R and D spending began several years before the introduction of the credit. Indeed, the rate of increase of company-financed R and D seems to have been no higher in 1981-83 than in 1979-81.[3]

Estimated Effect of the Credit

One potentially important source of information concerning the effect of the tax credit is the firms themselves. How much effect do the top executives of American industry believe that the R and D tax credit has had on their own firms' R and D expenditures? Although evidence of this sort should be treated with caution, it can be valuable in a variety of ways. To obtain such evidence, we surveyed a carefully-designed sample of all manufacturing firms spending over $1 million (or 1 percent of sales, if sales were at least $35 million) on R and D in 1981. This universe of firms accounted for $32.1 billion of company-financed R and D, or over 90 percent of the total. Considerable care was taken in the design of the sample. This universe of firms was separated into two strata, one stratum consisting of the 301 firms that spent $10 million or more on R and D in 1981, the other consisting of the 475 firms that spent between $1 million (or 1 percent of sales, if sales were at least $35 million) and $10 million. A random sample was chosen from each stratum. Optimum allocation rules were used to determine how many firms to pick from each stratum. The total sample size was set at 110 firms, since this seemed large enough to obtain the desired precision. As it turned out, the sample included about 30 percent of all company-financed R and D in the U.S. Fortunately, there was very little problem of non-response. Information was obtained from interviews and correspondence with a mixture of R and D executives, financial and tax executives, and chief executive officers. Although it is obvious that any estimate of this sort is rough, there was no indication that they felt that their estimates (of the extent to which the R and D tax credit increased their firm's R and D expenditures in 1981, 1982, and 1983) were subject to very large errors.

Based on the results, it appears that the R and D tax credit has had only a modest effect on firms' R and D spending (Table 1). Without the tax credit, the R and D expenditures of the 110 firms in the sample (which, to repeat, accounted for about 30 percent of all company-financed R and D in the U.S.) would have been about 0.4 percent lower in 1981, about 1.0 percent lower in 1982, and about 1.2 percent lower in 1983 than in fact was the case, according to the firms themselves. Using the customary statistical procedures we find that a 95 percent confidence interval for the total tax-credit-induced increase in R and D expenditures (by the population of 776 firms) in 1983 is $227 to $638 million, or 0.6 to 1.8 percent. For 1982, it is $151 to $538 million, or 0.4 to 1.5 percent. For 1981, it is $38 to $208 million, or 0.1 to 0.6 percent. Further, based on the firms' estimates, the extra R and D stimulated by the tax credit seems to have been considerably less than the revenue loss to the Treasury. For 1981, while the above confidence interval indicates that it is very unlikely that the tax-credit-induced R and D exceeded $208 million, the revenue loss was $600 million (according to the Treasury). For 1983, while the above confidence interval indicates that it is very unlikely that the tax-credit-induced R and D exceeded $638 million, the revenue loss was estimated to be about $1 billion.[4]

These results are quite consistent with the views of other economists who have studied this topic. Thus, Kenneth Brown of the American Enterprise Institute has stated that "my guess is that the credit's impact on actual (as opposed to reported) R and D was positive but too small to be measured."[5] The Congressional Budget Office, in its April 1984 study of federal support for R and D and innovation, concludes that "the incentives for increased

Table 1 -- Estimated Percentage Reduction in Company-Financed R and D Expenditures Without Tax Credit, 11 Industries, 1981-83

Industry	Percent Reduction[a]		
	1983	1982	1981
Chemicals and drugs	1.7	1.5	0.7
Electrical and electronics	0.4	0.3	0.0
Machinery (including computers)	1.0	0.7	0.0
Instruments	5.9	3.7	0.4
Metals and steel	4.9	2.4	4.2
Oil and oil supply	0.3	0.6	0.1
Aerospace	0.0	0.0	0.0
Telecommunications	1.4	1.4	1.5
Rubber	2.2	0.6	0.6
Paper	0.7	0.4	0.0
Other	0.3	0.2	0.2
Total	1.2	1.0	0.4

Source: Mansfield (1984).

[a] Figures have been rounded to the nearest tenth of a percentage point. Thus, 0.0 does not mean that the effect is zero.

R and D provided by recent changes in the tax system appear to be relatively minor."[6] Based on McGraw Hill's latest annual survey of companies' projected spending on R and D, David Braverman says that "The tax credit doesn't seem to have much effect on R and D spending."[7] It is noteworthy that there was so little evidence of a self-serving bias in the responses of the executives in our survey described above. Although firms tend to benefit from the credit, the executives were candid in saying that the effects were small.

Why Is the Effect So Small?

One reason why the effects are modest is that many firms are unaffected by the tax credit. Some firms, for a variety of reasons, want to cut back on their R and D expenditures. For example, 20 percent of the firms spending over $10 million on R and D in 1981 reduced their R and D spending from 1981 to 1982.[8] For firms that do not increase their R and D expenditures over the base amount, the credit is essentially irrelevant. In addition, some firms do not have any income tax liability against which to apply the credit. Although such firms can carry the credit forward to be claimed against future tax liabilities, this reduces its value to the firm and cuts its effectiveness. According to the Treasury, firms in 1981 could use only about 59 percent of the R and D tax credits, the rest being carried forward.[9]

For firms that do intend to increase their R and D expenditures over the base amount and that have an income tax liability against which to apply the credit, the after-tax price of an extra dollar's worth of R and D is reduced by the credit. However, for firms that intend to increase their R and D expenditures for each year in the foreseeable future (and this includes most firms, if for no other reason than that inflation pushes up nominal expenditures), the tax credit does not reduce the after-tax price of an extra dollar's worth of R and D by 25 cents. Because an extra dollar of R and D this year increases the base amount during the next three years, it reduces the credits available then. Assuming that the credit remains in effect for the following three years, the reduction (in cents) really equals only about 6 cents, if the interest rate is about 15 percent. And for firms that do not intend to raise this year's R and D expenditures above the base level or that do not have an income tax liability against which to apply the credit, the price reduction is far less than 6 cents.

According to Eisner, Albert, and Sullivan (1983), "the effective rate of credit for firms with tax liabilities and increasing R and D is in the order of only a few percent."[10] Although relatively little is known about the price elasticity of demand for R and D, the few available estimates[11] suggest that it is rather low, perhaps about 0.3. If this is the case, and if the tax-credit-induced price reduction is 6 percent or less, the tax credit would be expected to increase R and D by 1.8 percent or less, which compares with the 1983 confidence interval from the above survey of 0.6-1.8 percent. Thus, based on these crude estimates, the survey results seem eminently reasonable.

To What Extent Have Activities Been Redefined as R and D?

Long before the tax credit was introduced in 1981, economists and others pointed out that any such credit would encounter difficulties with regard to the definition of "research and development." Obviously, the credit provides firms with an incentive to redefine activities as R and D. The Treasury Department has asked Congress to tighten the definition of R and D. In May 1983, Assistant Secretary of the Treasury John Chapoton testified that: "The vagueness of this definition allows the assertion that the cost of developing virtually every product marketed in the economy should be treated under the . . . credit as qualified research expense. . . It is difficult to specify what pre-production expenses are research and experimental expenditures and what pre-production expenditures are not."[12]

To what extent has reported R and D expenditure increased merely because of the tax-credit-induced redefinition of activities as R and D? To obtain information on this score, we posed this question to a randomly selected subset of the firms in our sample. The results indicate that, taken as a whole, the reported R and D expenditures of these firms increased by about 4 percent per year during 1982-83 for this reason alone. Obviously, this estimate is very rough. Nonetheless, it is interesting to note that American experience in this regard, as measured by this estimate, is strikingly similar to the reported behavior of Canadian and Swedish firms described below. If our experience parallels theirs, this redefinition of activities as R and D will tend to peter out in the mid-1980s after reported R and D expenditures have risen in total by about 13 or 14 percent for this reason alone.

Clearly, this shift in definition makes it difficult to use the reported figures on R and D spending to estimate the effect of the credit. The reported figures are based on a rubber yardstick; there is no simple way to sort out increases in R and D activity from the effects of more inclusive definitions of R and D. One important advantage of the survey technique described above was that the firms were asked to estimate the effect of the tax credit on their R and D expenditures, holding constant the definition of R and D. Thus, the resulting estimates are based on an unchanging yardstick.

The R and D Tax Allowance in Sweden

From 1973 to 1983, Sweden had an R and D tax allowance. What were its effects? In Sweden, current R and D expenditures are deductible in the year in which they are incurred, and capital assets used for R and D must be depreciated over their normal economic life. In addition, in the early 1980s, there was an R and D tax allowance equaling 5 percent of a firm's R and D expenditure plus 30 percent of the increase over the previous year. To estimate the effects of this allowance, we carried out a survey of Swedish firms. The universe of firms was divided into two strata, one stratum being composed of the top 14 R and D spenders, the other being composed of all other firms. A random sample was chosen from each stratum; the total sample turned out to include more than 80 percent of all company-financed R and D in Sweden.

According to the firms in this sample, company-financed R and D expenditures would have decreased by about 1 percent in 1981 and 1983 if the tax allowance had not been in existence. As in the United States, it appears that the tax-incentive-induced increase in company-financed R and D was less than the revenue loss to the government. There are a number of reasons why the effects were small. Many firms did not have any income tax liability against which to apply the allowance. Even if a firm had such liabilities, the reduction (in cents) of the after-tax price of an extra dollar's worth of R and D to a firm that increased its R and D expenditure (and that intended to continue to increase its R and D expenditure for each year in the foreseeable future) was only about 3 or 4 cents, if the interest rate was about 15 percent.

Because the tax allowance was in existence for about a decade, it was possible to perform somewhat more extensive statistical analyses than in the United States, where there have been only a few years of experience with the tax credit. Based on our analysis of the official Swedish data, there was no evidence that the tax allowance resulted in a significant increase in the proportion of sales devoted to R and D. Thus, the statistical results were consistent with the survey findings. Although there are many dissimilarities between the Swedish and American economies, and any comparison between them must be viewed with caution, it is interesting that the estimated effects of the R and D tax incentives in the two countries are very similar.[13]

At the beginning of 1984, the Swedish government eliminated the R and D tax allowance. According to officials of the Swedish Royal Academy of Engineering Sciences, this was due in part to growing questions concerning the effectiveness of the allowance.

Direct R and D Tax Incentives in Canada

Canada was a pioneer in the adoption of direct R and D tax incentives. Both current and capital expenditures on R and D in Canada are fully deductible in the year incurred. In addition, during the early 1980s, there was both an R and D investment tax credit and a special research allowance. The investment tax credit (which was taxable) was 10-25 percent of current and qualified capital expenditures on R and D, the percentage varying with the size of the firm and the location of its R and D. The special research allowance permitted corporations to deduct from their taxable income an amount equal to 50 percent of the increase in operating and capital expenditures for R and D.

To estimate the effects of the Canadian R and D investment tax credit and the special research allowance on company-financed R and D, a survey like that in the United States and Sweden was carried out. We selected a stratified random sample of 55 firms, which account for almost 30 percent of the company-financed R and D expenditures in Canada. Based on these firms' estimates, it appears that in 1982 the investment tax credit increased company-financed R and D expenditures (when the definition of R and D is held constant) by about 2 percent, and that the special research allowance increased them by about 1 percent. Thus, the effect of these tax incentives seems to be about the same as the U.S. or Swedish tax incentives. As in the United States and Sweden, the increases in company-financed R and D expenditures seem to have been considerably less than the cost to the government in reduced tax revenue. Because of the availability of longer time series in Canada, it was possible to do more with econometric techniques there than in the United States or Sweden. While the econometric results are subject to a variety of limitations, they seem quite consistent with the survey results.[14]

In 1984, Canada changed its system of direct R and D tax incentives, the stated purpose being "to improve their effectiveness, to make them of more immediate value to firms performing R and D and to facilitate financing of R and D."[15] The special research allowance was eliminated, and the investment tax credit was increased by 10 percentage points for all R and D performers. In addition, to increase the extent to which these credits are actually utilized, firms now can renounce their unused credits and allow outside investors to claim these incentives. While this new system has attracted considerable public attention (and controversy),[16] it is so new that very little information is available concerning its effects.

Conclusions

While there is agreement in many quarters that American public policy should promote a greater investment in civilian technology, the available evidence does not indicate that the R and D tax credit, in its present form, is very effective in this regard. According to our survey results, the credit increased company-financed R and D in 1983 by only about 1 percent, and the amount of the credit-induced R and D spending was substantially less than the loss in tax revenue to the government. Of course, these results are subject to a variety of limitations, and should be viewed with considerable caution, but all of the evidence (survey, statistical, or econometric) from three quite different countries (United States, Sweden, and Canada) point in the same direction. After about two years of study, I have found no evidence to the contrary in these or a number of other countries.

Some observers argue that, although the effects of the U.S. R and D tax credit have been small, these effects would be much greater if the credit were known to be permanent. Perhaps so, but this is hard to square with the fact that the Swedish and Canadian R and D tax incentives were permanent -- and yet their effects were about as small as those of the U.S. tax credit. Moreover, given the fact that the existing R and D tax credit provides so little incentive for firms to increase their R and D, it is hard to see why its effectiveness would be enhanced significantly by making it permanent. So far as I know, no real evidence has been adduced to indicate that, if the credit were made permanent, this by itself would increase its effects significantly.

It has also been suggested that the credit would have more effect if it were altered in a variety of ways. In particular, some have proposed that the computation of the base amount (currently equal to the average of the firm's R and D expenditures in the previous three years) be changed so that there is more incentive for firms to increase R and D. For example, the base amount might be defined as the product of its average sales in the past few years multiplied by the industry-wide R and D-to-sales ratio. In my opinion, experimentation of this sort would be well worth considering. However, I think that previous experience (here and elsewhere) indicates that we cannot predict accurately the effects of changing the computation of the base amount. Only after we have some time to study the effects will we be in a position to say much about the effectiveness of such a revised tax credit.

In conclusion, it seems to me that it would be premature to make the present R and D tax credit a permanent part of the American tax system. In its present form, the credit seems to have only a modest effect on R and D expenditures (when the definition of R and D is held constant). In a revised form, it may be more effective, but no one really knows how much more effective it would be. In the absence of any real evidence that a revised credit would be very effective either, it seems to me to be more sensible to adopt a three-year extension (as the Treasury has proposed) during which the effects of a revised credit could be explored, than to assume that a revised credit would be effective and make it permanent.

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Footnotes

[1] For a description of these studies, see Mansfield et al. (1982). Of course, economists recognize that while there may be an underinvestment of this sort in some industries and in some types of R and D, this may not be true for other industries and other types of R and D.

[2] These Treasury estimates of tax losses come from Chapoton (1983). For further discussion of this topic, see Collins (1983).

[3] See Brown (1984).

[4] Of course, the increase in R and D pertains to the firms in the frame whereas the revenue loss pertains to all firms, but if the response of firms outside the frame was similar to those included in it, it is very unlikely that the tax-credit-induced R and D was as large as the government's revenue loss. For a much more detailed account of this study, see Mansfield (1984).

[5] Brown (1984), p. 37.

[6] Congressional Budget Office (1984), p. 97.

[7] "The R and D Outlook Is Sunnier than It Seems," Business Week, June 18, 1984, p. 16.

[8] See Business Week, June 20, 1983 and July 5, 1982.

[9] See Chapoton (1983). Also, see Chapoton (1984).

[10] Eisner, Albert, and Sullivan (1983), p. 25.

[11] See Mohnen, Nadiri, and Prucha (1983) and Nadiri and Schankerman (1981).

[12] See Chapoton (1983), p. 5.

[13] For a much more detailed account of the Swedish findings, see Mansfield (1984).

[14] See Mansfield and Switzer (1984).

[15] See Department of Finance (1983), p. iii.

[16] For example, see "Scientists Are Worried by Research Tax Credit," The Globe and Mail, June 11, 1984.

Chairman Rangel. Dr. Cordes of George Washington University.

STATEMENT OF JOSEPH J. CORDES, PH.D., ASSOCIATE PROFESSOR OF ECONOMICS, GEORGE WASHINGTON UNIVERSITY

Mr. Cordes. Thank you for giving me the opportunity to present my views to the subcommittee. Like the other two panelists, I would like to present a summary of a longer written statement which I would request to be included in the record.

Chairman Rangel. Without objection.

Mr. Cordes. So long as there is serious concern about the competitive position of American industry, there will continue to be considerable interest in identifying ways in which the public sector can encourage industrial innovation and technological change. The provision of tax incentives to firms which engage in R&D appears to be one means of providing such encouragement.

However, given equally if not more serious concerns about both the size of the Federal deficit and the continued erosion of the Federal tax base, it is important to critically evaluate the performance of such tax incentives. Such an evaluation requires that the following questions be addressed:

One, what rationale, if any, is there for providing financial incentives in any form to R&D?

Two, if there is a rationale for providing financial incentives to R&D, how should such incentives be structured?

Three, more specifically, is it best to provide such incentives directly through subsidies or indirectly through tax incentives, and if tax incentives are to be provided how should they be designed?

Four, given the issues raised in answering these three questions, how would one rate the performance of existing tax incentives for R&D?

Devoting resources to R&D and innovation is clearly an investment decision because it involves the current commitment of resources with the expectation of recovering the initial investment plus a return in the future. Such commitments must be financed in some manner, whether it be through the firm's internally generated funds or through external debt or equity capital.

The important policy question is: Are capital markets likely to provide adequate opportunities for economically promising, as distinguished from technically promising, innovations to obtain the appropriate level of financing?

In previous work I have done for the Office of Technology Assessment with my colleagues at George Washington University, James Barth and Michael Bradley, I have concluded that, with some exceptions, American capital markets are generally quite capable of allocating the appropriate level of financing to R&D and industrial innovation.

However, the exceptions are important because, (a) they involve an important class of innovative activities; and (b) by implication they suggest some general guidelines about how publicly financed financial incentives should be designed.

The two exceptions are: One, innovative activities of small start-up firms, who must rely on external rather than on internal sources of finance; and two, cases in which, though the innovation may yield social benefits which exceed its costs, the innovator may not be able to translate enough of those benefits into his own profits to justify the investment.

Given that there may be a case for providing public financial incentives in at least some, though not all, cases, how should such incentives be designed? In principle, the subsidy should be limited to R&D which is an input to innovations which are most likely to encounter financing barriers as a result of private market failure. That is, one would ideally be most concerned with subsidizing, (a) the R&D activities of new emerging firms and/or, (b) those R&D activities of all firms which are most closely linked to the development of innovations with substantial external benefits.

A further consideration in the design of such subsidies is the desired degree of direct Government involvement in the innovation process itself. If one believes, as I do, that private entrepreneurs are best able to make the numerous complicated scientific and technical judgments required to ultimately transform a good idea into a commercially viable product or process, then such involvement should ideally be kept to a minimum. However, it must be recognized that this latter objective of minimal interference may not be entirely compatible with the other objective of providing subsidies only to certain types of innovative activities.

The amount of Government discretion in determining who does and does not qualify for tax incentives typically tends to be rather limited. Thus, in deciding to subsidize R&D through the tax system, one is opting for the type of subsidy program just described, with both its advantages and disadvantages. The policy issue is how to preserve the advantages of minimal public involvement, while reducing, though not eliminating, the disadvantages.

Prior to 1981, the provision in the U.S. tax laws which affected R&D most directly was section 174 of the Internal Revenue Code, which allows firms to fully deduct outlays for R&D salaries and operating expenses, even though such outlays are intended to produce an intangible asset with a useful life of more than 1 year. Since this is equivalent to granting instantaneous depreciation to some portion of R&D, section 174 has long been regarded as providing a tax incentive to innovation. More recently, firms have for the first time been permitted to claim a tax credit for certain R&D spending equal to 25 percent of the amount by which "qualified research expenses" during the year exceed the average qualified expenses of the 3 preceding years.

Is the current mix of tax incentives, namely expensing combined with an incremental credit, the right mix? This question is really best answered in two parts:

First, is an R&D credit in any form necessary, given that R&D can be expensed? In my judgment the answer depends upon the generosity of other investment tax incentives. Since the tax system presently provides extremely generous writeoffs for investments in depreciable assets, an R&D credit in some form may be justified as a means of maintaining preexisting and relatively modest tax incentives for R&D. However, the case for an R&D credit is less compelling the greater is the relative value of R&D expensing, as would for example be the case under a capital cost recovery system which more closely approximated economic depreciation.

If an R&D credit is justified, is it more target efficient to have an incremental rather than a nonincremental credit? The Treasury Department data presented in my written statement suggest that it may be in some respects, but not others. At least in 1981, it appears that the incremental credit provided more subsidy dollars to smaller firms than would have been provided by a nonincremental credit of equal revenue cost. To the degree that the increased R&D spending reported by small firms represents a genuine interest in total R&D spending, the incremental credit may therefore have provided a greater stimulus to smaller firms to increase their R&D spending.

However, it also appears that nonmanufacturing firms have received more tax subsidies from the incremental credit than they would have received from a nonincremental credit of equal yield, while the incremental credit has been comparatively less generous to manufacturing firms.

The comparison is in some ways more striking if one examines the relative treatment of firms in high technology industries. I estimate that in the case of seven industries commonly classified as high technology, three would fare equally well under either an incremental or nonincremental credit, one would clearly be better off under an incremental credit, while three would actually be better off if an equal yield nonincremental credit were to be substituted for the current credit. By contrast, from the same data I estimate that firms in the trade and service sectors would receive significantly lower subsidies from a nonincremental credit.

For a variety of reasons mentioned in my written statement, it is at least arguable that R&D subsidies should be designed to provide relatively more incentives to manufacturing firms, especially high technology manufacturing firms. The fact that the incremental credit does not appear to have done so in 1981 suggests that making the credit incremental may not have increased the likelihood of subsidizing only R&D which is most likely to lead to major innovations with significant external benefits.

The basic conclusions I draw from the analysis are that: One, there may be some rationale for retaining an R&D credit as part of the current tax system; two, that this rationale would, however, be much less compelling if we had a capital cost recovery system for tangible assets which was more closely based on economic depreciation; three, that suggestions which you have heard for modifying the incremental character of the credit have some merit. The available evidence suggests that the incremental credit introduces added complexity with only uncertain payoff in terms of better distribution of the tax subsidy. I would personally favor giving serious consideration to replacing the current credit with a much simpler nonincremental credit set at perhaps 4 percent, so as to be revenue neutral with respect to the existing credit. Indeed, based upon Professor Eisner's estimates of the marginal incentives provided by the existing credit, it is quite likely that this simpler credit would provide the same or greater reduction in the hurdle rate of return facing R&D projects at no more revenue cost than is now being incurred.

Thank you.

[The prepared statement and a study follow:]

STATEMENT OF JOSEPH J. CORDES, ASSOCIATE PROFESSOR, DEPARTMENT OF ECONOMICS, GEORGE WASHINGTON UNIVERSITY

So long as there is serious concern about the competitive position of American industry, there will continue to be considerable interest in identifying ways in which the public sector can encourage industrial innovation and technological change. Provision of tax incentives to firms which engage in R&D appears to be one means of providing such encouragement. However, given equally if not more serious concerns about both the size of the federal deficit and the continued erosion of the federal tax base, it is important to critically evaluate the performance of such tax incentives.[1]

Such an such evluation requires that the following questions be addressed. (1) What rationale, if any, is there for providing financial incentives in any form to R&D? (2) If there is a rationale for providing financial incentives to R&D, how should such incentives be structured? (3) More specifically, is it it best to provide such incentives directly through subsidies, or indirectly through tax incentives, and if such financial incentives are to be provided through the tax system, how should such tax incentives be designed? (4) Given the issues raised in answering questions (1) to (3), how would one rate the performance of existing tax incentives for R&D?

1. PUBLICLY FINANCED FINANCIAL INCENTIVES FOR R&D

Devoting resources to R&D and innovation is clearly an investment decision because it involves the current commitment of resources with the expectation of recovering the initial investment plus a return in the future. Such commitments must be financed in some manner, whether it be through the firm's internally generated funds or through external debt or equity capital. The important policy question is: Are capital markets likely to provide adequate opportunities for economically promising—as distinguished from technically promising—innovations to obtain the appropriate level of financing? If the answer is "yes" then there is little rationale for publicly-provided financial incentives to R&D and industrial innovation because such financial incentives are already present in the private marketplace. If, however, the answer is "no", then publicly-financed financial incentives may be warranted as a means of remedying certain failures of the private market.

In work I have done for the Office of Technology Assessment with my colleagues, James R. Barth and Michael Bradley, I have concluded that, with some exceptions, American capital markets are generally quite capable of allocating the appropriate level of financing to R&D and industrial innovation.[2] However, the exceptions are important because (a) they involve an important class of innovative activities, and (b) by implication they suggest some general guidelines about how publicly-financed financial incentives should be designed.

Uncertainty and assymetric information

Historically, investments in technological innovation have promised high returns in exchange for high risk.[3] The uncertain nature of investments in innovation has sometimes been cited as one reason why such investments may fail to be undertaken, even though they appear to be potentially promising. However, one important lesson of modern financial and capital market theory is that uncertainty about future outcomes is not in an of itself a source of capital market failure. It certain conditions are satisfied, it can be easily demonstrated that risk and uncertainty will be properly reflected in asset prices and/or rates of return. This in turn implies that capital markets will allocate resources efficiently to risky investment activities, including investments in innovations. This is not to say that every potential innovator will be able to obtain the level of funding which she or he would like to have. Nor does it imply that the cost of capital will the same for risky as for risk-less projects. Nevertheless, it does imply that the premium which must be paid by innovators will be not be "out of line" with the true risks of the ventures they seek to finance.

However, this will not be the case if there are systematic obstacles to obtaining and/or acting upon relevant information about such investments. In the case of some innovations, particularly "important" innovations, it is quite likely that investors within the firm may have better information about the potential of the innovation than will outside investors. As a result of such "assymetric" distribution of information, the availability of internal sources of capital can become an important factor in the decision to innovate because access to external capital is limited. While this consideration may be relatively unimportant to larger, more established firms, it may be quite important in the case of newer, smaller firms. The latter group of firms plays an important role in the innovation process. Thus, it is conceivable that financial markets will fail to allocate the appropriate amount of capital to certain types of firms which have traditionally been an important source of innovations.

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[1] Several points in my testimony have been stimulated by conversations with participants in the Washington Tax Economists forum, especially Jane Gravelle and Charles Hulten, though the views expressed are entirely my own.

[2] See Barth, Cordes, and Bradley (1984).

[3] See Cordes (1979).

Failure to appropriate the full social benefits of R&D and innovation

Even if capital markets are functioning well—and indeed, precisely because they are functioning well—insufficient resources may be devoted to innovations if it is difficult to appropriate all of the economic benefits of the innovation. The potential problem the arises in such cases is that "even though the potential benefits to society may exceed the costs of innovation, the firm may not be able to translate enough of those benefits into its own profits to justify the necessary investment.[4]

How serious a problem is created by such lack of appropriability? The available data are limited. However, research conducted by Edwin Mansfield and his associates provides the following insights. Among the 17 industrial innovations studied by Mansfield et al. (1977), 12 produced an estimated flow of social returns in excess of the private returns earned by the innovators. In 5 of these 12 cases, the private return was sufficiently low that, if endowed with the wisdom of hindsight, the innovators might not have undertaken the investment needed to develop the innovation, even though such investments would have been justified on the basis of their social returns. In 5 of the 17 cases, the social return to the innovation was either roughly equal to or less than the private return to the innovators.

The policy implications of these results may be summarized as follows. (1) Based on past experience, there is evidence that social returns to innovations can exceed the private returns. (2) In some cases this divergence may cause insufficient resources to be devoted to some innovations which are socially but not privately profitable. However, (3) there are also likely to be many instances in which the private returns are sufficiently high to encourage private investment in the innovation, even though the social return may exceed the private return.

2. DESIGN OF PUBLIC FINANCIAL INCENTIVES FOR R&D AND INNOVATION

Given that there may be a case for providing public financial incentives to at least some innovators, how should such incentives be designed? First, to the extent there is a rationale for some form of subsidy, such a subsidy should ideally be based on the outputs of the innovation process—that is, the innovations themselves—rather than on inputs into that process, such as R&D. If such subsidies are ruled out as an option, the next-best alternative may be to subsidize the costs of certain inputs, such as R&D, which are unique to the innovation process.

However, such subsides should be limited to R&D which is an input into those innovations which are most likely to encounter financing barriers as a result of private market failure. That is, one would ideally be most concerned with subsidizing (a) the R&D activities of new, emerging firms, and (b) those R&D activities of all firms which are most closely linked to the development of innovations with substantial external benefits.

A further consideration in the design of such subsidies is the desired degree of direct government involvement in the innovation process itself. If one believes, as I do, that private entrepreneurs are best able to make the numerous and complicated scientific and technical judgments required to ultimately transform a good idea into a commerically viable product or process, then such involvement should ideally be kept to a minimum. However, this latter objective of minimal interference may not entirely compatible with the objective of providing subsidies only to certain types of innovative activities.

3. PUBLIC OVERSIGHT AND THE ALLOCATION OF SUBSIDIES

The twin objectives of minimal government involvement and effective targeting of the subsidy are relatively compatible in the case of new, emerging firms. That is, determining whether R&D is being conducted by a new, emerging firm is something that can be easily observed without requiring much additional information about the activities of the firm.

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[4] See National Science Foundation (1977). p.126.

Assessing whether a given innovation has significant external benefit is another matter altogether. Prof. Mansfield and his associates argue that the ratio of external to private returns is likely to be higher: (a) if the innovator is in a competitive as opposed to a monopolistic or oligopolistic environment, (b) in the case of "major" as opposed to "minor" innovations, and (c) in the case of product as opposed to process innovations. In addition, others have argued tht basic research is more likely to yield external benefits than is applied research.

It is difficult to see how these criteria could be used to design an R&D subsidy program which provided subsidies only to R&D likely to generate significant external benefits, yet which also required only limited information on the characteristics of the firm, as well as limited discretion by government bureaucrats administering the subsidy. The possible exception might be the case of basic vs. applied research if it were possible to define each category of R&D in such a way as to minimize the need for case-by-case judgments as to which type of R&D activity was "basic." Hence, once one moves beyond the realm of subsidizing only the R&D activities of small, emerging firms, one faces the following policy dilemma. If one is to subsidize research and development in general, one must choose between: (1) a program with minimal government involvement which has a high probability of subsidizing "deserving" as well as "undeserving" R&D spending and (2) a program with significant government oversight intended to reduce wasteful spending of subsidy dollars, but which also requires greater direct public involvement in the industrial innovation process.

Design of tax incentives for R&D

The amount of governmental discretion involved in determining who does and does not qualify for tax incentives typically tends to be rather limited. Thus, in deciding to subsidize R&D through the tax system, one is opting for the first type of subsidy program described immediately above with both its advantages and disadvantages. The policy issue is how to preserve the advantages of minimal public involvement while reducing, though not eliminating the disadvantages.

In this context, several points deserve mention. First, in light of the above discussion, such incentives shoud be designed so that new, emerging firms are at least as able to benefit from such incentives as are their larger counterparts. Second, to the maximum extent possible, the general guidelines for determining eligibility should be written in such a way as to maximize the likelihood that the R&D which qualifies is associated with innovations which promise significant external benefits. Third, the issue of whether the tax incentive should be based on total vs. incremental R&D spending should be decided with reference to the preceding two criteria. That is, an incremental tax incentive should be preferred to a nonincremental tax incentive if the former type of incentive is more likely to treat new, emerging firms appropriately and is more likely to subsidize R&D with substantial external benefits (and vice versa).

4. CURRENT TAX INCENTIVES FOR R&D

Prior to 1981, the provision in the U.S. tax laws which affected R&D most directly was Section 174 of the Internal Revenue Code, which allows firms to fully deduct outlays for R&D salaries and operating expenses, even though such outlays are intended to produce an intangible asset with a useful life of more than one year. Since this is equivalent to granting instantaneous depreciation to some portion of R&D, Section 174 was long regarded as providing a tax incentive to innovation.

More recently, R&D was singled out for special treatment in ERTA in two ways. First, special provisions for the tax depreciation of R&D equipment were incorporated in ACRS. Though these provisions had certain features which made them appear favorable to R&D activities, they may actually have had the opposite impact under the ERTA, though not under TEFRA.

More important, firms were for the first time permitted to claim a tax credit for certain R&D spending. Specifically firms were allowed to claim a tax credit equal to 25 percent of the amount by which "qualified research expenses" during a year exceed the average qualified expenses of the three preceeding years, with the additial qualification that the base may never be less than 50 percent of current qualified expenditures. In effect, this latter provision reduces the rate of incremental credit to 12.5 percent on each dollar of incremental R&D above an amount equal to 100 percent of the base. Qualified research expenses are those defined in keeping with Section 174. If the firm pays other parties to conduct R&D, 65 percent of such purchases are deemed to be qualified research expenses. If a firm undertakes R&D outlays which qualify for the credit, but is unable to claim the credit against current tax liabilities, the same carry-back and carry-forward rules which apply to the investment tax credit apply to any unused credit. This provision is presently scheduled to expire as of January 1, 1986.

Impact of R&D expensing

The principal effect of allowing R&D to be expensed is to reduce the total pre-tax return that investments in innovation would have to earn in order to enable investors to: (a) pay taxes due on the returns to the innovation, (b) provide a return of capital, and (c) provide the desired after-tax real return to capital. If one thinks of this required total pre-tax return as a "hurdle" or "threshold" rate of return, which a given investment project would have to meet or exceed in order to qualify for funding, then the main effect of Section 174, prior to 1981, was to lower the hurdle rate of return that innovation-oriented investments would have to earn as compared to more traditional investments.

It is difficult to precisely quantify the magnitude of this incentive effect. However, some rough calculations presentd in Barth, Cordes, and Tassey (1984) suggest that, whereas in the absence of expensing, an hypothetical innovation project would have had to earn roughly 1.4 times the pre-tax return of a traditional investment project in order to be competitive, with expensing that same project would only have to earn 1.16 times as much.

The incentive value of Section 174 was significantly reduced as a result of the ACRS system enacted as part of ERTA. Modifications to ACRS which were made as part of TEFRA have restored some of the relative tax advantage enjoyed by R&D-intensive investments. However, it is still an open question whether, in the abscence of tax incentives in addition to R&D expensing, innovation-oriented investments would enjoy as favorable a relative position under current tax rules as they did prior to 1981.

Impact of the R&D tax credit

Because the R&D tax credit also reduces the pre-tax hurdle rate faced by R&D-intensive projects, its enactment as part of ACRS has helped to preserve the relative tax advantage enjoyed by R&D prior to 1981. Because of the complex nature of the incremental credit, it is difficult to precisely quantify whether the credit as presently structured does less than, exactly as much as, or more than is required to maintain the pre-1981 tax status of R&D. In my own research I have estimated that a non-incremental R&D credit with a revenue loss equivalent to the current incremental credit, when combined with expensing, would certainly maintain, and in all likelihood enhance the relative tax advantage enjoyed by R&D.[5] Thus, if one believes that the level of implicit tax incentives provided to R&D prior to ERTA was either correct or inadequate, an R&D tax credit in some form might be justified as a means of preserving the desired structure of relative investment incentives. A corollary of this proposition is that it might not be necessary to have both expensing of R&D and an R&D tax credit if tax incentives for investments in depreciable capital were less generous.

Specific performance of the R&D credit

However, justification of the R&D tax credit based on the fact that it maintains pre-1981 relative tax incentives begs two important questions. First, was R&D expensing prior to 1981 a "target efficient" tax subsidy to begin with? Second, if it was, is the current R&D tax credit as target efficient.

Target efficiency of expensing

There is no hard evidence on whether the ability to expense Section 174 R&D has led private industry to undertake socially "desirable" investments in innovation which it otherwise might have made. Given the nature of expensing, we have reason to believe that this incentive effects the required pre-tax return in the same way as an interest subsidy so that it provides that same marginal tax incentives to short-lived as to long-lived R&D projects. Such neutrality is generally regarded to be a desirable property of tax incentives for depreciable capital. But it may be less desirable in the case of R&D if one believes that the ratio of external to private benefits is related to whether the R&D spending is for short- or for long-lived R&D. Moreover, the implicit incentive provided by expensing would be extended to all firms whose spending was considered to be R&D under the definitions of Section 174, and therefore not necessarily limited to those forms of R&D with significant potential external benefits. Finally, like all financial incentives extended through the tax system, expensing would actually be of value only to firms with positive tax liabilities. As Dildine and Milner (1983) have shown, this latter feature can have the effect of significantly raising the pre-tax hurdle rate faced by small, start-up firms, as compared to more establish and profitable firms. Hence, for all of the above reasons, the pattern of actual financial incentives to R&D due to expensing will imperfectly approximate the socially optimal pattern.

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[5] See Barth, Cordes, and Tassey (1984), and Fullerton and Lyons (1983).

Response of firms to the R&D credit observed from tax return data

By comparison with expensing, there is considerable information available on how firms have initially responded to the R&D tax credit. This information is available from four different sources: (a) surveys of individual companies conducted by Edwin Mansfield; (b) surveys conducted by the McGraw-Hill Company; (c) data compiled from corporate reports on the Compustat data tapes, and (d) data from 1981 tax returns tabulated by the U.S. Treasury Department. Because the testimony of other panelists will examine in some detail the implications of the data obtained from sources (a) through (c), I will focus my comments on the policy implications of the Treasury data.

Table 1 presents data on the amount of R&D tax credits earned and claimed as well as on the distribution of those credit among different segments of American industry. Columns (4) and (7) show that in 1981 American firms were eligible to receive roughly $.9 billion in tax credits, of which some $.6 billion was actually used to reduce 1981 tax liabilities. Column (3) shows that the amount of tax credits earned was the result of an average growth in qualified R&D spending relative to base R&D spending of 40.25 percent. One important question is whether this growth would have occurred in any event. However, given that R&D spending was growing at a rate of 10-15 percent in the years immediately prior to 1981, it seems likely that part of this reported increase was a direct response to the tax credit.

As is seen from both columns (5) and (7), most of tax credits were earned and claimed by manufacturing firms. However, the share of credits received by such firms was less than their share of qualified R&D in the base period. By comparison, the share of credits received by the nonmanufacturing sectors, particularly public utilities, trade, and services, was greater than their share of base period qualified R&D. The reason for this is readily seen from column (3); the growth in qualified R&D among manufacturing firms was less than among nonmanufacturing firms.

Table 2 provides additional information on the distribution of R&D tax credits among firms of different size within particular industrial groupings. In virtually all cases, firms reporting qualified R&D spending greater than 100 percent of base period spending—"high growth" firms—were significantly smaller—in terms of total assets—than firms reporting less rapid growth. Though they are not reported here, tabulations in which firm size is measured in terms of total receipts show the same pattern.

Taken together, these results suggest that the initial impact of the R&D tax credit may be characterized as follows. First, there appears to have a substantial increase in the scope of activities classified as R&D for tax purposes. Second, this increase has been the greatest among smaller firms generally, and among nonmanufacturing firms in particular.

Target efficiency of the R&D tax credit

Are tax credits for R&D likely to be target efficient? As in the case of expensing, the way in which tax credits affect the required rate of return provides some limted insight into this question. Like expensing, the implicit subsidy provided by tax credits is of full value only to firms who either have positive tax liabilities in the current year, or sufficient ability to carry back credits to previous years. As is shown by the data in Table 1, a significant share of tax credits are earned by firms who are unable to fully claim such credits against current tax liabilities. Some fraction of these "initially unclaimed" credits would still be usable immediately through carrybacks. However, in related research which I have done on the utilization of investment credits, I have found that the ability to carryback is relatively modest.[6] Thus, as in the case of expensing, the effective incentive provided by an R&D credit will be less than the statutory incentive. Indeed, as Eisner, et al. (1984) have shown in such cases an incremental credit may actually encourage firms to postpone currently planned R&D spending to future years.

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[6] See Cordes and Sheffrin (1983).

TABLE 1.—DISTRIBUTION OF R&D TAX CREDITS

[Dollar amounts in thousands]

Industry	Total base qualified R&D (1)	Total 1981 R qualified R&D (2)	Percent change in qualified R&D (3)	Tentative credit (4)	Share of tentative credit (5)	Share of base qualified R&D (6)	Credit claimed (7)	Share of credit claimed (8)	Percent of credit claimed (9)
Agr. for. and fish	$17,343	$24,604	41.87	$1,739	0.20	0.18	$1,115	0.18	64.12
Mining	4,886	8,218	68.19	685	.08	.05	288	.05	42.04
Crude pet. and gas	71,859	127,338	77.21	12,253	1.41	.75	10,065	1.59	82.14
Contr. constr	11,423	24,820	117.28	2,580	.30	.12	1,910	.30	74.03
Food and tobacco	231,890	314,607	35.67	20,157	2.31	2.42	12,906	2.04	64.03
Textiles and app	39,650	65,080	64.14	5,284	.60	.41	4,678	.74	89.14
Paper and print	25,474	53,689	110.76	5,606	.64	.27	4,967	.79	88.60
Petrol. refin	420,743	782,697	86.03	73,779	8.46	4.39	71,376	11.28	96.74
Chem. and rubber	1,681,586	2,210,235	31.44	131,254	15.05	17.55	95,385	15.08	72.67
Wood and stone prod	301,055	408,111	35.56	25,643	2.94	3.14	20,392	3.22	79.52
Mach. and misc. man	3,613,314	4,920,423	36.17	297,701	34.14	37.71	199,693	31.57	67.08
Transp. equipt	396,021	523,864	32.28	29,516	3.38	4.13	15,196	2.40	51.48
Motor vehicles	1,161,974	1,416,135	21.87	63,110	7.24	12.13	36,366	5.75	57.62
Trans. comm. util	1,232,984	1,848,175	49.89	134,756	15.45	12.87	114,907	18.17	85.27
Trade	69,238	125,144	80.74	11,353	1.30	.72	8,672	1.37	76.39
Fin. ins. real e	172,148	292,313	69.80	25,470	2.92	1.80	16,036	2.54	62.96
Services	130,733	294,066	124.94	31,177	3.58	1.36	18,546	2.93	59.49
N.A.	369	587	59.08	55	.01	.00	55	.01	100.00
Total	9,582,690	13,440,106	40.25	872,082	100.00	100.00	632,553	100.00	72.53
Agr. for. and fish	17,343	24,604	41.87	1,739	.20	.18	1,115	.18	64.12
Mining and extrac	76,745	135,556	76.63	12,938	1.48	.80	10,353	1.64	80.02
Contr. constr	11,423	24,820	117.28	2,580	.30	.12	1,910	.30	74.03
All manuf	7,871,707	10,694,841	35.86	652,014	74.77	82.15	460,959	72.87	70.70
Tran. comm. util	1,232,984	1,848,175	49.89	134,756	15.45	12.87	114,907	18.17	85.27
Trade and services	372,488	712,110	91.18	68,055	7.80	3.89	43,309	6.85	63.64

Source: Office of Tax Analysis.

TABLE 2.—GROWTH IN QUALIFIED R&D SPENDING AND SIZE OF TOTAL ASSETS

[In thousands of dollars]

Industry	Average assets					
	Full credit		Partial credit		No credit	
	High growth [1]	Other	High growth [1]	Other	High growth [1]	Other
Agr. For. and Fish	$4,116	$37,120	$59.940	$13,507	N.A.	N.A.
Mining	N.A.	900,864	N.A.	N.A.	229,773	379,641
Crude pet and gas	211,163	512,769	17,303	N.A.	157,529	661,647
Contr. constr	19,493	159,894	7,313	780,226	N.A.	N.A.
Food and tobacco	46,278	801,485	15,886	327,512	44,797	95,792
Textiles and app	29,107	78,547	36,517	54,465	N.A.	N.A.
Paper and print	54,244	278,607	N.A.	36,804	N.A.	76,206
Petrol. refin	N.A.	17,816,057	N.A.	N.A.	619,814	2,812,507
Chem. and rubber	12,178	303,183	4,506	1,416,958	7,364	244,443
Wood and stone prod	13,484	192,545	4,852	75,104	119,185	912,096
Mach. and misc. man	21,803	216,041	5,420	412,145	11,532	218,900
Transp. equipt	13,195	258,881	N.A.	N.A.	157,495	571,272
Motor vehicles	22,764	1,683,279	N.A.	N.A.	157,495	571,272
Tran. comm. util	71,844	799,428	2,870	126,305	41,418	34,467
Trade	139,776	308,387	1,325,980	1,589,231	30,192	200,053
Fin. ins. real e	1,575,158	4,804,650	64,954	17,368,562	985,379	4,361,514
Services	11,606	131,130	4,127	17,659	N.A.	N.A.

[1] Firms with qualified R&D more than double base R&D spending.

Source: Office of Tax Analysis.

One important difference between tax credits and expensing is that credits will not have a neutral effect on the pre-tax hurdle rates facing short- and long-lived R&D. If the R&D credit were to become permanent, it would, like the investment tax credit, favor shorter-lived relative to longer-lived assets, and hence favor relatively short-lived R&D projects. If more rapid depreciation in the value of the R&D asset is also associated with a higher ratio of external to private benefit, this lack of neutrality would be an attractive attribute of R&D credits. However, if, as some have argued, basic, longer-lived R&D is also more likely to result in innovations with significant social benefits, the tendency of R&D credits to favor shorter-lived, more applied R&D would render R&D tax credits less target efficient than expensing.

Relative target efficiency of incremental versus nonincremental credits

Does making the credit incremental make it more target efficient? The data in Tables 1 and 2 suggest that it may in some respects but not others. The relationship between growth in qualified spending and firm size implies that for a given revenue cost, smaller firms would be eligible for larger amounts of tax credit under an incremental than a nonincremental credit. Moreover, the data underlying Table 2 also indicate that this increased relative eligibility was not significantly offset by any differences in ability to actually claim credits among smaller versus larger firms. Thus, at least in 1981, it appears that the incremental R&D credit provided more subsidy dollars to smaller firms than would have been provided by a nonincremental R&D credit of equal revenue cost.

To the degree that increased R&D spending by "high growth" firms would not have occurred in the absence of the credit, this would seem to imply that for a given revenue cost, the incremental credit has provided a greater incentive to smaller firms to increase their R&D spending. If so, this would be a desirable outcome. However, this conclusion is subject to two important qualifications. First, as Robert Eisner has shown, if most small, high growth firms would have more than doubled their spending in any event, the current 50 percent floor on the base would actually reduce the incentive faced by such firms as compared to firms with slower growing R&D.[7] Second, without additional information, we do not know whether the increased spending by high growth firms represents an increase in total R&D, or whether it represents a reclassification as qualified R&D of existing spending.

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[7] See Eisner et al. (1984), and Brown (1984).

From Table 1 it also appears that nonmanufacturing firms have received more tax subsidies from the incremental credit than they would have received from a nonincremental tax credit of equal yield. Conversely, as compared to a nonincremental credit, the incremental credit has been relatively less generous to manufacturing firms.

The comparison is even more striking if one examines the relative treatment of firms in industries traditionally classified as high technology industries. Based on less complete, but more disaggregate tabulations prepared by the Treasury Department, I have estimated the amount of tax subsidy received under both an incremental and a nonincremental R&D tax credit by the following industries: drugs and pharmaceuticals, office computing and accounting machinery, communications equipment, electronic components, aircraft and guided missiles, optical and ophthalmic goods, and scientific instruments. Three of these high technology industries (office and computing machinery, optical and ophthalmic goods, and scientific instruments) would receive roughly the same amount of subsidy; one industry (electronic components) would receive significantly more under an incremental credit; and three industries (pharmaceuticals, aircraft and missiles, and communications equipment) would receive larger tax subsidies under a nonincremental credit. By contrast, using the same data, I estimate that firms in the service sector would receive significantly lower tax subsidies from a nonincremental R&D credit than from an equal yield incremental credit.

Based on a series of study financed by the National Science Foundation, there is ample historical evidence that (1) almost 90 percent of all major innovations have been developed by manufacturing firms, (2) that within the manufacturing sector, high technology, R&D intensive industries have been responsible for a significant share of these innovations, and (3) that a smaller share of the cost of financing major innovations has been subsidized by public grants or contracts in the manufacturing than in the nonmanufacturing sector. It is therefore at least arguable that R&D subidies should be designed to provide relatively more incentives to manufacturing firms, especially high technology firms. The fact that the incremental R&D credit does not appear to have done so in the 1981 suggests that making the credit incremental may not make it more target efficient. That is, if the response of firms in 1981 is indicative of future behavior, making the credit incremental may not have increased the likelihood of subsidizing only R&D which is most likely to lead to major innovations with significant external benefits.

5. SUMMARY AND POLICY RECOMMENDATIONS

Should tax incentives be provided to R&D? Based on the discussion above, there is a basis for extending financial incentives to some but not to all types of R&D activities. In choosing to provide such incentives through the tax system rather than through direct spending programs, one is choosing to rely on a subsidy machanism which allows for little discretion as to who ultimately qualifies for the subsidy. Such limited discretion has important advantages and disadvantages. However, given that one has chosen to provide subsidies indirectly through the tax system, one should structure the tax incentive so as to minimize the disadvantages of limited oversight.

Is the current mix of tax incentives, namely, expensing combined with an incremental R&D credit, the right mix? This question is best answered in two parts. First, is an R&D credit in any form necessary, given that R&D can be expensed? In my judgement, the answer depends on the generosity of other investment tax incentives. To the extent that the tax system provides extremely generous write-offs to investments in depreciable assets, as is the case under the current ACRS system, an R&D credit in some form may be justified as a means of maintaining pre-existing, and relatively modest, tax incentives for R&D. However, the case for an R&D credit is less compelling, the greater is the relative value of R&D expensing as would, for example, be the case under a depreciation system which more accurately reflected economic lives of depreciable assets.

If an R&D credit can be justified, given the current tax system, how should it be structured? In this context I would like to address two proposals for modifying the credit which have recently been made. The first is that the credit be made refundable. While clearly this would help make the incentive provided by the credit more neutral among firms, the existing data do not show that the problem of utilization is any more serious in the case of the R&D credit than it is in the case of investment credit. Hence, while I am generally sympathetic to the principle of making credits refundable—or better yet, simply transforming them into open-ended explicit subsidies—it would be prudent tax policy to consider this issue apart from the more general issue of whether all tax credits should be made refundable.

A second set of proposals pertain to modifying the base of the R&D tax credit. It has variously been proposed that the definition of "qualified" R&D be expanded to include items such as purchases of computer software, and that the basis for defining incremental R&D be modified. Given that there is considerable uncertainty about whether the observed increase in qualified R&D constitutes an increase in total R&D or merely a reclassification of existing activities, expanding the definition of qualified R&D would not seem prudent, especially if the items included in the expanded definition are not likely to be associated with the development of innovations with significant external benefits.

Proposals for modifying the incremental features of the credit have more merit. However, evaluations of such modifications should be based on two "targeting" criteria: (1) How does the change affect smaller firms? and (2) Does the change increase the likelihood that more tax subsidies will flow to innovative activities with large potential external benefits? Based on the response of firms to the credit in 1981, proposals which would, in effect, make the credit less incremental, would appear to get good marks in terms of the second but not the first criterion.

Lastly, great caution should be exercised in drawing any policy conclusions from the observed behavior of firms in 1981. One reason is that in 1981 many firms were still experiencing the impact of the most severe recession in postwar history. Another reason is that for a variety of reasons, the incentive provide by the current temporary credit is likely to be strongest in 1985, the last year of its existence. Finally, because the credit is temporary in nature, the observed response of firms may offer few clues about how they would react if the credit were to become permanent.[8]

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[8] For a fuller discussion of these points see Eisner et al. (1984), Mansfield (1984), and Barth, Cordes, and Tassey (1984).

THE IMPACT OF RECENT CHANGES IN TAX POLICY ON INNOVATION AND R&D*

1. INTRODUCTION

During the latter half of the 1970s, there was a widely-expressed concern that the climate for innovation in the United States had become less favorable. This perceived decline in innovation activity was believed to have significant adverse implications for the well-being of the U.S. economy. As a result, numerous efforts were made to examine the reasons for the perceived decline in innovation and to identify public policies that would further encourage innovation.[1]

As part of this examination, several studies analysed the relation between innovation and tax policy.[2] Though these studies disagreed as to which specific tax policy initiatives were the most appropriate means of encouraging innovation and technical change, there was considerable agreement that the rate of innovation was likely to be particularly sensitive to certain broad areas of tax policy. These areas were: (1) taxation of income from capital in general, (2) taxation of income from depreciable capital, (3) tax treatment of investments in R&D, (4) taxation on new, emerging firms, and (4) taxation of income from risky investments.

Major changes have been made in both the corporate and the personal income tax since the completion of these studies. The basic changes were enacted in the Economic Recovery Tax Act (ERTA) of 1981, though some of the tax reductions initially provided by ERTA were subsequently reduced by the Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982. The principal thrust of the Reagan administration's tax policy has been to provide general incentives to saving, investment, and work effort, rather than to specifically encourage innovation and technological change. However, many of the recent changes in tax policy have been in those areas also considered to be especially relevant to the innovation process.

This paper examines some of the more significant ways in which the incentives of firms to innovate may have been affected by recent changes in tax policy. In focusing on the tax incentives facing firms, we eschew consideration of tax provisions such as the phased-in 23 percent reduction in marginal personal income tax rates contained in ERTA. To the extent that incentives in tax rates (along with other elements of supply-side economics) achieve their stated policy goals of higher economic growth and lower inflation, they should also foster a more favorable climate for technological innovation.

The importance of tax policies that improve the general economic climate and which thereby enhance the profitability of investments in innovation should not be underestimated.[3] However, our objective is to examine those tax policies which have rather direct and tangible impacts on the innovation process. In evaluating these policies, we will focus on two broad issues: (1) the extent to which recent tax policy changes are likely to affect the demand for certain types of innovation, notably capital goods innovations, and (2) the impact of tax policy changes on the propensity of firms to devote resources to investment projects whose objective is the development of innovations.

In addressing these issues, two related themes will be stressed. The first is the importance of distinguishing between scale and substitution effects of tax policies. Shifts in tax policy affect economic behavior by changing the after-tax rewards from engaging in various economic activities. Such changes in tax policy can be structured so as to uniformly increase or decrease the economic rewards from different activities without altering the structure of relative rewards. Policy changes of this type would therefore have scale but not substitution effects. Alternatively, tax policies can affect the economic rewards to different activities in a non-uniform manner so that the structure of relative rewards is changed. Such tax policy changes will have both scale and substitution effects, the impacts of which may be either reinforcing or offsetting. This distinction is particularly relevant to assessing the impact of recent tax policy changes on R&D and innovation. It is widely recognized that recent tax legislation provides incentives which generally tend to favor investment. It is, however, less certain whether recent tax changes have improved, maintined, or diminished the position of innovation-related investments relative to more traditional investments. Consideration of this issue leads to the paper's second theme: the need to view tax policy as a set of interrelated rather than isolated incentives.

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[1] For a general discussion of these issues, see Hannay and Landau (1981).

[2] See Cordes (1981).

[3] Cordes (1980).

The outline of the paper is as follows. The next section briefly describes the specific tax policy changes to be examined, and summarizes the current method for empirically measuring the effects of such changes on investment incentives. Section 3 then discusses the impact of these tax policy changes on the demand for innovations in capital goods. Section 4 examines the impact of tax policy shifts on the propensity of firms to innovate. Section 5 presents a summary of the analysis as well as some broad policy conclusions.

2. THE ACCELERATED COST RECOVERY SYSTEM AND THE R&D TAX CREDIT

Two recent changes in tax policy are likely to affect the incentives of firms to engage in industrial innovation. The first is the Accelerated Cost Recovery System (ACRS) which speeds up the rate at which business capital can be depreciated for tax purposes. The second is the adoption of an R&D tax credit based on incremental R&D spending.

Of the two measures, the impact of ACRS on federal revenues is by far the more dramatic. According to estimates prepared by the Joint Committee on Taxation, the version of ACRS initially enacted in 1981 as part of ERTA accounted for roughly 20 percent of the total tax reductions and 96 percent of the business tax reductions resulting from ERTA. Concern about the impact of large projected federal budget deficits led to the modification of some of the original provisions of ACRS as part of an overall package of tax increases included in the Tax Equity and Fiscal Responsibility Act (TEFRA) of 1982.[4] As a consequence of these modifications, the capital cost recovery provisions of the corporate income tax are somewhat less generous than they would have been under ERTA, but still more generous than they were prior to 1981. By comparison, the Joint Committee on Taxation has estimated that the R&D tax credit accounts for only 0.4 percent of the tax reductions resulting from ERTA. However, its modest scope notwithstanding, the adoption of the R&D tax credit is significant because it is the first time that a tax credit in any form has been extended to R&D.

A. Accelerated cost recovery

The Accelerated Cost Recovery System continues a post-war trend of providing federal tax incentives for capital spending. Since 1954 these incentives have taken two principal forms: (a) allowing firms to take progressively more accelerated depreciation deductions in 1954, 1962, and 1971, and (b) allowing firms to claim tax credits for new investment spending in 1962, 1964, and in 1978 when the investment tax credit—which hitherto had not been a permanent feature of the tax code—was made permanent.

Prior to the enactment of ACRS, deductions for the cost of using depreciable capital were based on the Asset Depreciation Range System (ADRS). Under the ADRS efforts were made to match the stream of nominal depreciation deductions for the cost of an asset with the stream of income earned by the asset. Once the ADRS life was determined, taxpayers were generally allowed to deduct capital costs over the ADRS life using either a straight-line formula or one of two accelerated depreciation formulas. In addition, tax payers were allowed to claim a tax credit for new investment in equipment, though not in structures. The actual amount of the credit varied with the length of the useful life of the equipment, as shown in the first column of Table 1.

By comparison with the ADRS system, ACRS places all depreciable assets in one of four classes based on their previous ADRS midpoint life. These classes determine the length of time over which capital costs may be written off for tax purposes. As seen from the last two columns of Table 1, the recovery period permitted for different types of assets—3 years, 5 years, and 15 years—are generally shorter than the corresponding periods under the ADRS system. In addition, ACRS replaced the various depreciation formulas which were allowed under ADRS with a set of pre-established recovery rates which determine the percentage of capital costs which can be written off in any given year. These rates were scheduled to be replaced in 1985 and 1986 by a revised set of recovery rates which increased the percentage of capital costs which could be deducted in the early years of an asset's life. However, both the 1985 and 1986 recovery rates were repealed as part of TEFRA.

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[4] See, Barth and Morrell (1982), and Barth and Cordes (1982).

TABLE 1.—CAPITAL COST RECOVERY PERIODS AND INVESTMENT TAX CREDITS UNDER ACRS AND ADR

Asset	Investment tax credit		Cost recovery periods (useful lifetimes)	
	Old law	ACRS	Old law	ACRS
Furniture and fixtures	0.100	0.100	8.00	5.00
Fabricated metal products	.100	.100	10.00	5.00
Engines and turbines	.100	.100	12.48	5.00
Tractors	.067	.100	5.00	5.00
Agricultural machinery	.100	.100	8.00	5.00
Construction machinery	.100	.100	7.92	5.00
Mining and oil field machinery	.100	.100	7.68	5.00
Metalworking machinery	.100	.100	10.16	5.00
Special industry machinery	.100	.100	10.16	5.00
General industrial equipment	.100	.100	9.84	5.00
Office and computing machinery	.100	.100	8.00	5.00
Service industry machinery	.100	.100	8.24	5.00
Electrical machinery	.100	.100	9.92	5.00
Trucks, buses, and trailers	.067	.100	5.00	5.00
Autos	.033	.067	3.00	3.00
Aircraft	.100	.100	7.00	5.00
Ships and boats	.100	.100	14.40	5.00
Railroad equipment	.100	.100	12.00	5.00
Instruments	.100	.100	8.48	5.00
Other equipment	.100	.100	8.16	5.00
Industrial buildings	0	0	28.80	15.00
Commercial buildings	0	0	47.60	15.00
Religious buildings	0	0	48.00	15.00
Educational buildings	0	0	48.00	15.00
Hospital buildings	0	0	48.00	15.00
Other nonfarm buildings	0	0	30.90	15.00
Railroads	.100	.100	24.00	15.00
Telephone and telegraph	.100	.100	21.60	15.00
Electric light and power	.100	.100	21.60	15.00
Gas	.100	.100	19.20	15.00
Other public utilities	.100	.100	17.60	10.00
Farm	0	0	25.00	15.00
Mining, shafts, and wells	0	0	6.80	5.00
Other nonbuilding facilities	0	0	28.20	15.00
Residential	0	0	40.00	15.00
Inventories	0	0		
Land	0	0		

Source: Fullerton and Kodrzycki (1981), p. 13.

The rate of investment tax credit allowed for certain short-lived assets is also somewhat more generous under ACRS than under ADRS. This may be seen by comparing the first two columns of Table 1. Initially, as under ADRS, taxpayers claiming the credit were not required to reduce the cost basis for claiming depreciation deductions by the amount of the credit received. However, under TEFRA, taxpayers will be required to make a so-called "basis adjustment". In the case of assets qualifying for the 10 percent tax credit, taxpayers will generally be required to reduce the cost basis for computing depreciation deductions by 5 percent of the purchase price of the asset. In the case of assets qualifying for the 6 percent tax credit, the corresponding adjustment is 3 percent of the purchase price.

B. Incremental tax credit for R&D

Prior to 1981, the provision in the U.S. tax laws which affected R&D most directly was Section 174 of the Internal Revenue Code. Section 174 permits firms to fully deduct outlays for R&D salaries and operating expenses, even though such outlays are intended to produce an intangible asset with a useful life of more than one year. Since this is equivalent to granting instantaneous depreciation to some portion of R&D, Section 174 has long been regarded as providing a tax incentive to innovation.

R&D was singled out for special treatment in ERTA in two ways. First, special provisions for the tax depreciation for R&D equipment were incorporated in ACRS.

Second, firms have for the first time been permitted to claim a tax credit for certain R&D spending. Specifically, firms are allowed to claim a tax credit equal to 25 percent of the amount by which "qualified research expenses" during a year exceed the base period level of such expenses. The base period level is the average qualified expenses of the three preceeding years. Qualified research expenses are those defined in keeping with Section 174. If the firm pays other parties to conduct R&D, 65 percent of such purchases are deemed to be qualified research expenses. If a firm undertakes R&D outlays which qualify for the credit, but is unable to claim the credit against current tax liabilities, the same carry-back and carry-forward rules which apply to the investment tax credit apply to any unused R&D credit. Finally, the R&D credit is scheduled to expire as of January 1, 1986.

C. Measuring the general impacts of investment tax incentives

In order to assess the impacts of both ACRS and the R&D credit on incentives for innovation, it is first necessary to consider the general issue of how to measure the economic impact of investment tax incentives. One procedure that has been frequently used for this purpose is based on a user-cost-of capital formula of the sort initially developed by Hall and Jorgenson (1967):

$$(1)\ \frac{c}{q} = \frac{(\delta(1-u)i-\pi)(1-k-uz)}{(1-u)}$$

where: c is the flow of rentals generated by a unit of the asset, q is the price per-unit of capital, δ is the rate of economic depreciation (as distinguished from depreciation allowed for tax purposes), u is the marginal corporate tax rate, i is the level of nominal interest rates, π is the inflation rate, k is the rate of tax credit per dollar of investment, and z is the present value of tax depreciation deductions flowing from $1 of new investment. If, as in TEFRA, the firm must reduce the amount of depreciation deductions by some fraction, b, of the investment credit claimed, expression (1) becomes:

$$(1)'\ \frac{c}{q} = \frac{(\delta+(1-u)i-\pi)(1-k-(1-bk)uz)}{(1-u)}$$

The ratio c/q measures the cash flow per dollar invested which must be earned by the asset in order to both return the capital lost through depreciation and to pay a return to the capital initially invested. Hence, the difference (c/q)-δ measures the return earned by the asset net of depreciation but gross of taxes. If we let (c/q)-δ=R, either (1) or (1)' may be used to solve for the value of R which must be earned in order for the asset to earn some desired after-tax real rate of return, $r^* = (1-u)i-\pi$, given some assumptions about the inflation rate and relevant tax parameters. This value of R is the "required pre-tax return". The size of the effective tax wedge between the pre- and after-tax rates of return on each investment may then be calculated as (R-r), where r is the required after-tax real return. The effective tax rate on each investment can be estimated from the ratio (R-r)/R.

As Bradford and Fullerton (1981) have recently noted, estimates of the effective tax rate calculated from the general form (R-r)/R may be highly sensitive to empirical assumptions used to estimate the required pre-tax return. Moreover, calculated values of the effective tax rate are undefined when R is zero and makes little economic sense for values of R close to zero. Hence, rather than use estimated effective tax rates, we have chosen to compare the impact of different cost recovery rules in terms of the required pre-tax real return—R—that different assets would have to earn to provide an investor with a 4 percent real return after corporate taxes.

Table 2 presents estimates of R under several different tax regimes. These estimates are calculated from data generated by the Depreciation Model developed by the Office of Tax Analysis, U.S. Treasury Department. The first column of Table 2 presents calculations of the required return, R, which different assets would have to earn in order to provide an after-tax real return of 4 percent given an 8 percent inflation rate, and tax parameters consistent with the 1986 fully phased-in version of ACRS enacted in ERTA. Column (3) presents calculations using tax parameters consistent with the version of ACRS which reflects the changes made in TEFRA.

The estimates in Table 2 indicate that ACRS will not provide equal incentives to all types of capital investment.

Some Caveats

In interpreting the estimates in Table 2, two qualifications should be kept in mind. First, the estimates are sensitive to the assumed fixed value of the inflation rate, π. At the lower values of π, the absolute values of R under ADRS and both versions of ACRS would be less than those presented in Table 2. It is unclear, however, whether the pattern of changes relative to ADRS reported in Table 2 would be appreciably affected by different values of π. Second, the estimates in Table 2 are most properly interpreted as comparisons between investment incentives implicit in two different tax regimes (each yielding equal total revenue) believed to be permanently in place. Third, the estimates capture the impact of only corporate tax changes on R, assuming that other factors, such as the expected levels of future sales (roughly captured by c), the level of nominal interest rates (i), and the required after-tax real return (r), do not change. If any of these variables change at the same time as the tax policy variables, the actual change in R relative to the base-period may be more or less than that shown in Table 2. Thus, the estimates in Table 2 are best viewed as comparing the values of R in two different equilibrium states which are alike in all respects save for the type of permanent tax rules which govern capital cost recovery.

TABLE 2.—REAL PRE-TAX RATE OF RETURN REQUIRED TO PROVIDE A 4-PERCENT REAL AFTER-TAX RETURN

ACRS class and asset detail	ADR (1)	1982 version of ACRS in ERTA (2)	1986 version of ACRS in ERTA (3)	Version of ACRS as modified in TEFRA (4)
3-year	4.9	3.5	2.8	4.4
Automobiles	4.8	3.5	2.8	4.4
Light trucks	4.8	3.5	2.8	4.5
Small tools	5.0	3.4	2.6	4.5
5-year	5.2	3.8	3.1	4.4
Machinery and equipment	5.1	3.8	3.2	4.3
Heavy trucks	4.7	3.6	2.5	4.6
Computers	4.5	3.6	2.4	4.7
Vessels	6.1	3.9	3.4	4.3
Aircraft	5.5	3.7	2.9	4.5
Bus-vehicle	4.5	3.6	2.5	4.6
Steam	5.5	3.9	3.6	4.2
Furniture and fixtures	4.6	3.8	3.2	4.3
Small tools	4.7	3.5	....	4.9
10-year	7.1	5.7	4.9	6.1
Machinery and equipment	7.0	5.7	4.9	6.1
Pollution	6.5	5.2	4.6	5.4
15-year	9.5	7.8	6.7	8.0
Machinery and equipment	9.5	7.8	6.7	8.0
15-year	8.1	6.6	6.6	6.6
Buildings	8.1	6.6	6.6	6.6

Source: Depreciation model, Office of Tax Analysis, U.S. Treasury Department.

3. ACRS AND DEMAND-PULL IN CAPITAL GOODS INNOVATIONS

Studies examining the relation between innovation and tax policy have identified inadequate capital recovery as an important factor in contributing to a slowdown in rates of innovation and technological change. This contention is based in part on some empirical evidence which links changes in capital goods innovations to changes in capital spending.

The quantitative significance of ACRS on the rate and pattern of innovation in capital goods depends on the empirical significance of the induced innovation effect. To date, the principal empirical evidence on the link between capital spending and induced innovation is based on the pioneering research of Jacob Schmookler (1969) and a recent updating of Schmookler's empirical analysis by F. M. Scherer (1982).

In both Schmookler's and Scherer's analyses, annual data on capital goods patents are used as a proxy variable for the output of capital goods innovations. These data are grouped according to industry of use so that, for example, a capital good patent which would be used by steel producers would be assigned to the steel industry. The empirical question examined in both studies is whether there is a stable and significant relationship between changes in the real investment spending of industries likely to use various capital goods innovations and the amount of patents granted for capital goods innovations likely to be used in those industries.

Based on cross-section data on patents and capital spending in 23 innovation-using industries, Schmookler found evidence that changes in investment spending would, after a lag of two years, lead to or cause, changes in the output of innovations. Moreover, the estimates suggested that this relationship would be basically proportional. That is, a one percentage point change in capital spending would lead to a one percentage point change in the output of patents for capital goods.

In a recent paper, Scherer has updated Schmookler's cross-section analysis. In general, Schmookler's earlier qualitative results were confirmed, though Scherer's estimated elasticity of innovations with respect to investment spending, which ranges from .44 to .69, was considerably lower than Schmookler's estimates of 1.0.

The calculations in Table 2 show that ACRS reduces the required pre-tax return which must be earned by investments in capital spending. If the demand for capital goods is sensitive to the required rate of return, ACRS should cause capital spening to be higher than it otherwise would have been. According to the "demand-pull" hypothesis, this should also result in a higher than otherwise rate of innovation in capital goods by stimulating the market or demand for such innovations. However, the calculations in Table 2 also show that ACRS will reduce the required return proportionately more for some assets than for others. This implies that the pattern of innovations induced by ACRS will most likely differ both by type of capital good and by industry.[5]

4. TAX POLICY CHANGES AND R&D

In addition to affecting the level and composition of demands for capital goods innovations, recent tax policy changes also directly affect the after-tax payoff to R&D. In examining these effects we first consider the impact of ACRS on R&D assuming that no R&D tax credit had been enacted. We then consider the separate impact of permitting tax credits for R&D. Finally we examine the impact of ACRS and the R&D tax credit combined.

A. ACRS and R&D

There are four principal ways in which changes in cost recovery can affect R&D spending. First, depreciable capital is a significant component of some types of R&D. In general, however, the capital intensity of R&D projects will differ so that the impact of changes in cost recovery rules will be greater for some types of R&D projects than for others. Second, if depreciable assets used in R&D are treated differently from other depreciable assets, as is the case in ACRS, the required pre-tax return which must be earned by R&D relative to other investment activities will be directly affected. Third, because cost recovery rules affect business cash flow, and hence business liquidity, R&D may be affected if R&D spending is sensitive to liquidity. Finally, if changes in cost recovery rules move the tax treatment of non-R&D business capital either closer to, or further from expensing, the relative tax value of R&D expensing will either be reduced or enhanced.

ACRS and depreciable capital used in R&D

Presently there are no industry-wide data available on the share of R&D costs which are attributable to the use of depreciable capital. However, data compiled by the National Science Foundation can be used to construct a crude index of R&D factor intensity. These data are R&D expenditures by industry and scientists and engineers employed in R&D by industry. The ratio of R&D labor to R&D expenditures can be viewed as an index of R&D labor intensity. It is plausible to assume that the percentage of R&D costs attributable to the use of depreciable capital will decline with the labor intensity of R&D. Hence, the inverse of the ratio of R&D scientists and engineers to R&D expenditures may be viewed as a rough index of the capital intensity of R&D in various industries. Column (3) of Table 3 presents estimates of this index, while column (4) presents the capital intensity rank of each industry, based on the value of this index. These estimates suggest that R&D is the most capital intensitive in: motor vehicles, petroleum refining and extraction, and aircraft and missiles; and the least capital intensive in: textiles and apparel, fabricated metals, and other munfacturing.

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[5] This conclusion presumes that the statistical relationship between capital spending and capital goods innovations is a casual one. In preliminary work, we have attempted to test this assumption more formally using statistical exogeneity tests. Our preliminary findings lend support to one version of Schmookler's hypothesis: that capital goods innovations are induced by changes in real stock prices: but not another: that capital goods innovations are induced by changes in real investment spending. These results apply only to a single industry during a particular period of time. However, they suggest that further testing of the induced innovation hypothesis is warranted. If these findings are replicated, it would be appropriate to examine the link between tax-induced shifts in required real pre-tax returns and stock prices, in order to assess the impact of tax policy on induced innovation.

TABLE 3.—RATIO OF TOTAL R&D EXPENDITURES TO TOTAL NUMBER OF SCIENTISTS AND ENGINEERS EMPLOYED IN R&D ACTIVITIES

Industry	Average R&D spending in constant dollars (1976-79) (1)	Average number of R&D engineers and scientists (1976-79) (2)	$\frac{\text{Column (1)}}{\text{Column (2)}}$ (3)	Industry rank (4)
Food and kindred	282.3	7.1	39.8	15
Textiles and apparel	58.3	1.8	32.4	18
Lumber, wood and furniture	88.0	2.2	40.0	14
Paper and allied	254.0	6.3	40.3	13
Chemicals	3,258.0	46.8	50.4	7
Petroleum refining and extraction	674.0	9.6	70.2	2
Rubber	349.0	8.4	41.5	12
Stone, clay and glass	208.0	4.9	42.9	11
Primary metals	377.0	8.2	46.0	9
Fabricated metals	272.5	7.2	37.8	17
Machinery except electrical	2,921.8	57.6	50.8	6
Electrical machinery	4,391.0	84.2	52.1	4
Motor vehicles	2,403.3	29.3	82.0	1
Transportation equipment	84.0	1.9	44.2	10
Aircraft and missiles	5,041.3	76.8	65.6	3
Professional and scientific instruments	1,113.8	21.4	52.0	5
Other manufacturing	176.3	4.5	39.0	16
Non-manufacturing	709.3	15.3	46.4	8

Source: Science Indicators 1980.

It is tempting to conclude from these results that ACRS will tend to favor R&D activities in those industries in which R&D is the most capital intensive. However, as has been shown in Table 2, the magnitude of the tax incentive provided by ACRS will differ by the type of asset. Thus, it is theoretically possible that while R&D in a particular industry might be relatively labor intensive, the capital which was employed in that industry might consist of assets which were relatively favored by ACRS. If so, the tendency of ACRS to favor capital-intensive R&D would at least be partially offset by the tendency of ACRS to favor the specific assets used in R&D. Alternatively, if industries with capital-intensive R&D also used depreciable assets in R&D which were favored by ACRS, the tendency of ACRS to favor R&D in capital intensive industries would be reinforced.

One crude way of further examining this issue is to compare rankings of industry by R&D capital intensity with rankings of industries by the impact of ACRS on the required pre-tax return to depreciable assets. In the latter case, the rankings are based on estimates of the impact of ACRS by industry taken from the U.S. Treasury Department Depreciation Model. The specific estimates are not presented in this paper. However, the rankings of industries, both under ERTA and under TEFRA, are presented in columns (2) and (3) of Table 4. The coefficient of correlation computed between columns (1) and (2) is .07 while the corresponding coefficient of correlation between columns (1) and (3) is −.23. Neither of these correlations is statistically significant. This indicates that there is no systematic relation between the tax incentives to capital spending provided by ACRS and the capital intensity of an industry's R&D activities. That is, the tendency of ACRS to favor specific assets appears to neither offset nor reinforce the tendency of ACRS to favor capital intensive R&D. This lends some support to the contention that ACRS wil tend to favor R&D in industries which rely heavily on capital intensive R&D.

TABLE 4.—INDUSTRIES RANKED BY R&D CAPITAL INTENSITY AND ACRS STIMULUS

Industry	R&D capital-intensity rank (1)	Percent reduction in required return ERTA version of ACRS (2)	Percent reduction in required return TEFRA version of ACRS (3)
Motor vehicles	1	1	9
Petroleum, refining and extraction	2	2	1
Electrical machinery	3	13	13
Machinery and instruments	4	10	9
Chemicals	5	10	12
Primary metals	6	5	4
Transportation equipment	7	9	8
Stone, clay and glass	8	3	2
Rubber	9	5	4
Paper and allied	10	4	6
Lumber, wood products and furniture	11	10	6
Food and kindred	12	8	11
Fabricated metals	13	5	3

[1] The rankings in this table differ from those in tables 7, 8, and 10 because some industries are excluded for purposes of comparability.

Placing of R&D equipment in the 3-year ACRS class

One provision of ACRS which applies specifically to depreciable assets is the assignment of all R&D equipment to the 3-year recovery class, regardless of the useful life of such equipment under the ACRS system. Because non-R&D equipment is assigned to either the 5-year or 10-year class, this provision would appear to favor R&D by allowing the capital costs of equipment used in R&D to be deducted more rapidly than the capital cost of equipment generally.

However, while R&D equipment may be written off more rapidly than other equipment, equipment used in R&D will be eligible for a smaller investment credit than non-R&D equipment. The reason, as shown in Table 6, is that assets in the 3-year class will qualify for a 6 percent investment credit as compared to a 10 percent credit for other equipment.[6]

Table 5 presents some illustrative calculations of the likely impact under both versions of ACRS of placing all R&D equipment in the 3-year class. The calculations in column (6) show that with the exception of R&D equipment with a pre-ACRS life of 3 years, the required pre-tax return which would have to be earned by R&D equipment under the 1986 ERTA version of ACRS would exceed the pre-tax return which would have to be earned by non-R&D equipment of comparable durability. The reason is that under ERTA the relative disadvantage of qualifying for a lower investment credit more than offsets the relative advantage of being able to deduct capital costs within 3 rather than 5 years. However, column (7) shows that under the TEFRA version of ACRS, R&D equipment is treated somewhat more favorably than non-R&D equipment. That is, the required pre-tax return for R&D equipment is less than that for comparable non-R&D equipment. The reasons are that the relative advantage of being able to write R&D equipment off more rapidly is greater under the depreciation schedules allowed by the TEFRA version of ACRS, and that the adjustment of the depreciable basis required by TEFRA reduces the relative disadvantage of qualifying for a lower credit.

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[6] Taxpayers may choose to write off R&D equipment over a longer period of time than 3 years. However, such equipment would still be deemed to be 3 year equipment for the purposes of claiming the investment tax credit. For a related discussion, see Zakupowsky and Sunley (1982).

TABLE 5.—COMPARATIVE IMPACT OF GROUPING R&D EQUIPMENT IN THE 3-YEAR RECOVERY CLASS

Asset lives and interest credits				Required before tax return		
Pre-ACRS		Post-ACRS		Pre-ACRS [1]	ERTA version of ACRS	TEFRA version of ACRS
Asset life (years)	Investment credit (percent)	Asset life (years)	Investment credit (percent)			
(1)	(2)	(3)	(4)	(5)	(6)	(7)
			R&D equipment			
9.1	10.0	3.0	6.0	5.2	3.5	4.15
7.0	10.0	3.0	6.0	4.3	3.4	4.19
5.0	6.7	3.0	6.0	4.6	3.2	4.25
3.0	3.3	3.0	6.0	4.9	2.8	4.38
			Non-R&D equipment			
9.1	10.0	5.0	10.0	5.2	3.2	43.0
7.0	10.0	5.0	10.0	4.3	3.1	4.40
5.0	6.7	5.0	10.0	4.6	2.8	4.50
3.0	3.3	3.0	6.0	4.9	2.8	4.38

[1] Pretax return required to earn an aftertax real return of 4 percent when the inflation rate is assumed to be 8 percent. The estimated required pretax returns are calculated under the assumption that the economic depreciation rate equals 1/T where T is the pre-ACRS asset lifetime.

TABLE 6.—IMPACT OF ACRS [1] ON TAX CASH FLOW BY INDUSTRY

Industry	Present value of tax cash flow before ACRS	Present value of tax cash flow after ACRS	Change in the present value of tax cash flow due to ACRS	Percent change in present value of tax cash flow due to ACRS	Absolute increase in cash flow due to ACRS (rank)	Percent increase in cash flow due to ACRS (rank)
	(1)	(2)	(3)	(4)	(5)	(6)
Agriculture	38.7	41.1	2.4	6.2	21	21
Mining	40.7	43.5	2.8	6.8	19	20
Logging	39.8	42.1	2.3	5.8	22	22
Wood products and furniture	35.7	39.8	4.1	11.5	10	10
Glass, cement, and clay	36.0	41.5	5.5	15.2	3	4
Primary metals	36.2	41.9	5.7	15.7	1	3
Fabricated metals	37.2	40.9	3.7	9.9	13	13
Machinery and Instruments	37.0	40.6	3.6	9.7	15	14
Electrical machinery	39.3	41.4	2.1	5.3	23	23
Motor vehicles	42.2	44.2	2.0	4.7	24	24
Transportation equipment	37.2	40.7	3.5	9.4	16	16
Food	35.3	40.4	5.1	14.4	5	5
Tobacco	36.0	41.7	5.7	15.8	1	2
Textiles	39.2	40.5	1.3	3.3	25	25
Apparel	36.3	39.7	3.4	9.4	18	16
Pulp and paper	39.0	43.0	4.0	10.2	11	12
Printing and publishing	38.1	41.6	3.5	9.2	16	18
Chemicals	39.3	42.0	2.7	6.9	20	19
Petroleum refining	37.9	43.0	5.1	13.5	5	7
Rubber	37.4	42.1	4.7	12.6	8	9
Leather	34.8	39.4	4.6	13.2	9	8
Transportation services	39.6	43.4	3.8	9.6	12	15
Utilities	32.3	36.0	3.7	11.5	13	10
Communications	35.7	40.8	5.1	14.3	5	6
Service and trade	31.9	37.1	5.2	16.3	4	1
Total	35.9	40.0	4.1	11.4	n.a.	n.a.

[1] Impact of the version of ACRS which incorporates changes made in TEFRA.

Liquidity, cash flow, and R&D

In addition to affecting the required pre-tax return which must be earned by investments in depreciable assets, ACRS will also affect corporate cash flows and, hence, corporate liquidity. Cash flow, F, defined as:

$$(3) \quad F_t=(R_t-D_t)(1-u)+D_t+ITC_t=R_t(1-u)+uD_t+ITC_t$$

where R is corporate profits before depreciation deductions, u is the corporate tax rate, D is depreciation deductions allowed for tax purposes, and ITC is the investment credit. From equation (5) it is readily seen that the change in cash flow due to a change in capital cost recovery rules is:

$$(4) \quad \Delta F=u\Delta D+\Delta ITC$$

where ΔD is the change in depreciation and ΔITC is the change in the investment tax credit.

It has been argued that because of the uncertain payoff to investment in innovation, firms will be reluctant or unable; to obtain external funds to finance the development of a new product or process. Therefore, it is argued, a substantial R&D effort is more likely to be undertaken by firms which can draw on a substantial pool of internally generated funds—i.e., on cash flow. If R&D spending responds positively to cash flow, the liquidity effect of ACRS described in equation (4) should, therefore, have a positive impact on R&D outlays.

Empirical evidence on the relationship between R&D spending and liquidity is mixed. Mueller (1967) and Grabowski (1968) both find a significant positive relationship between R&D expenditures and liquidity variables. However, other studies by Hamberg (1960), Scherer (1965), Elliott (1971), and Smyth, et al. (1972), fail to detect a significant relationship between R&D and liquidity. In summarizing this evidence, Kamien and Schwartz (1975) conclude that the evidence in favor of the hypothesis that liquidity will significantly effect R&D is, at best, mixed. However, they caution (1975, p.26) that "failure to support the hypothesis may not indicate the lack of importance of this variable. Liquidity or profitability may be threshold factors', necessary is some degree for R&D activity, but not linearly related to the amount of innovative activity".

Thus, whether the liquidity effects of ACRS will have a favorable impact on R&D spending depends on whether there is a positive and significant relationship between R&D outlays and liquidity. To date, the empirical evidence on this point is mixed. However, to the extent there is some positive relationship, the liquidity effects of ACRS may vary among industries.

An approximate indication of how different depreciation schemes will affect cash flows may be obtained by estimating and comparing the present value of tax cash flow per $1 of new investment, defined as:

$$(5) \quad PV_F=uZ+k$$

where u is the tax rate, Z is the present value of depreciation deductions generated by $1 of new investment, and k is the investment tax credit; per $1 of new investment. Table 6 presents estimates of (5) by industry under both ADRS and under the TEFRA version of ACRS. The values of Z and k are taken from estimates calculated by the Treasury Department depreciation model of the present value of depreciation deductions under both sets of depreciation rules. Columns (5) and (6) rank the industries by the projected absolute and percentage increase, respectively, in liquidity due to the enactment of ACRS.

It is interesting to compare the rankings in columns (5) and (6) of Table 6 with a grouping of industries according to R&D intensity. This is done in Table 7. The first three columns of Table 7 are taken from Science Indicators 1976, while columns (4) and (5) are taken from Table 6. The data in Table 7 show that the cash flow benefits of ACRS will not favor R&D-intensive industries. Indeed, the most R&D intensive industries are ranked relatively low in terms of the cash flow benefits of ACRS.

TABLE 7.—MEASURES OF R&D INTENSITY, BY INDUSTRY, 1961–74, COMPARED WITH INDUSTRY RANKINGS FROM TABLE 14

Manufacturing industry	Mean over the 1961–74 period: R&D scientists and engineers per 1,000 employees (1)	Mean over the 1961–74 period: Total funds for R&D as a percent of net sales (2)	Mean over the 1961–74 period: Company funds[1] for R&D as a percent of net sales (3)	Absolute increase in cash flow due to ACRS (rank) (4)	Percent increase in cash flow due to ACRS (rank) (5)
GROUP I					
Chemical and allied products	37.8	3.8	3.4	20	19
Machinery	26.1	3.9	3.2	[2]15	[2]14
Electrical equipment and communication	46.1	8.2	3.6	23	23
Aircraft and missiles [3]	85.4	19.1	3.3	[4]n.a.	[4]n.a.
Professional and scientific instruments	33.8	5.8	4.2	[2]15	[2]14
Mean for group I	46.1	7.7	3.4		
GROUP II					
Petroleum refining and extraction	15.8	.8	.8	5	7
Rubber products	17.4	1.9	1.6	8	9
Stone, clay, and glass products	10.8	1.6	1.5	3	4
Fabricated metal products	12.2	1.3	1.2	13	13
Motor vehicles and transportation equipment	19.8	3.3	2.6	24	24
Mean for group II	14.4	1.9	1.2		
GROUP III					
Food and kindred products	7.1	.4	.4	5	5
Textiles and apparel	3.1	.5	[5].4	[6]25, 18	[6]25, 18
Lumber, wood products, and furniture	5.0	.5	[5].4	10	10
Paper and allied products	8.3	.8	[3].8	11	12
Primary metals	5.5	.7	.7	1	3
Mean for group III	6.0	.6	.4		

[1] Include all sources other than the Federal Government.

[2] Machinery and instruments are combined in the Treasury data.

[3] Includes ordnance.

[4] Not available.

[5] Data for company funds are not available for several years. Means computed using only those years for which data is available.

[6] Separate rankings for textiles and apparel, respectively.

Source: Table 4-16, Science Indicators 1976 and table 14.

Relative value of R&D eexpensing

The impacts of different tax regimes, including ACRS, on the relative value of R&D expensing are easily evaluated using the concept of the required pre-tax return. The basic relationship to be used for this purpose is equation (6). Equation (6) defines the real pre-tax return, ρ which must be earned in order to earn a desired, or "target", after-tax return of r on an investment which is partially expensed. The fraction of the investment which may be expensed equals α, while $(1-\alpha)$ is the fraction of the investment subject to normal capital cost recovery rules. The effective mariginal tax rate on the entire investment equals m, while e and s are the effective marginal tax rates on the expensible and non-expensible portions of the investment, respectively. The real pre-tax return is then

$$\text{(6)} \qquad \frac{r}{1-m} = \rho = \alpha \frac{r}{(1-e)} + (1-\alpha)\frac{r}{(1-s)} .$$

Under expensing, it can be readily shown that the effective marginal tax rate is zero, so that $e=0$, while for the portion of the investment which cannot be expensed, $s \neq 0$. Thus, if we let $R=r/(1-s)$ represent the required real pre-tax return which must be earned in order for the non-expensible portion of the investment to earn an after-tax real return of r, equation (6) may be rewritten as

$$(7)\qquad \frac{r'}{1-m}=\rho=\alpha r+(1-\alpha)R$$

Because R&D is a much more important input into investments in innovation than into other, more traditional investments, α is likely to be greater for investments in innovation than for other investments. Indeed, a reasonable first approximately may be to assume that $\alpha>0$ for investments in innovation and $\alpha=0$ for other, non-innovation-oriented, investment activities. Under this assumption, the real pre-tax returns which must be earned by innovation and non-innovation-oriented investments are given by

$$(8)\qquad \rho_I=\alpha r_I+(1-\alpha)R_I, (\alpha>o)$$

$$(9)\qquad \rho_T=\alpha r_T+(1-\alpha)R_T=R_T, (\alpha=o)$$

where ρ_I is the real pre-tax return which must be earned by an innovation-oriented investment in order to earn a real after-tax return of r_I, and ρ_T is the corresponding real pre-tax return which must be earned by a "traditional" (i.e. non-innovation-oriented investment) in order to earn a real after-tax return of r_T. Because innovation-oriented investments are riskier than traditional investments, it is plausible to assume that the former type of investment must earn a higher real after-tax return than the latter type of investment—i.e., that $r_I>r_T$.

Form (8) and (9), the relative required pre-tax return which must be earned by an innovation-oriented investment as compared to another investment is

$$(10)\qquad \rho_I/\rho_T=\frac{\alpha r_I+(1-\alpha)R_I}{R_T}$$

Expression (10) can be used to evaluate how various tax regimes affect the relative attractiveness of innovation-oriented as compared to traditional investments. As the ratio (ρ_I/ρ_T) increases, the rate of return threshold, ρ_I which innovation-oriented investments must meet or exceed increases relative to the corresponding threshold, ρ_T, which more traditional investments must meet or exceed. That is, as (ρ_I/ρ_T) increases, innovation-oriented investments become relatively less attractive. Conversely, as (ρ_I/ρ_T) decreases, innovation-oriented investments must meet a relatively less stringent rate of return test, and hence become relatively less attractive.

From (10) it is readily seen that the ratio (ρ_I/ρ_T) increases as R_T falls and decreases as R_T rises. Because R_T is the required pre-tax return which must be earned by traditional investments in depreciable capital. R_T will decrease as capital cost recovery provisions become more generous, and increase as capital cost recovery provisions become less generous. Thus, a change in tax regime, such as substitution of ACRS for ADRS, which permits non-R&D capital to be recovered more rapidly, can have the effect of increasing the ratio (ρ_I/ρ_T), thereby reducing the relative attractiveness of R&D-intensive investment projects.

The estimates in Table 8 illustrate the impact of ACRS on the relative position of R&D-intensive investments. In these calculations, we allow the share of total innovation costs which qualify for R&D expensing to vary from 0.1 to 1.0. The required real after-tax return is assumed to be 6 percent for innovation-oriented investments, 4 percent for traditional investments, and the average pre-tax returns which must be earned under different tax regimes if depreciable capital used in U.S. manufacturing is to earn an after-tax return of 6 precent. The values used for R_I are the corresponding pre-tax returns when the required after-tax return is 4 percent.

TABLE 8.—RELATIVE POSITION OF R&D INTENSIVE INVESTMENTS

Value of α	Before ACRS			After ACRS (ERTA)			After ACRS (TEFRA)		
	ρ_I	ρ_T	ρ_I/ρ_T	ρ_I	ρ_T	ρ_I/ρ_T	ρ_I	ρ_T	ρ_I/ρ_T
$\alpha=0.1$	9.96	7.5	1.33	7.4	5.1	1.46	8.5	6.5	1.31
$\alpha=0.4$	8.64	7.5	1.16	6.96	5.1	1.36	7.7	6.5	1.18
$\alpha=0.8$	6.88	7.5	.92	6.32	5.1	1.24	6.6	6.5	1.01
$\alpha=1.0$	6.00	7.5	.80	6.00	5.1	1.17	6.0	6.5	.92

As is seen in Table 9, the required pre-tax return which must be earned by R&D-intensive investment projects either has not been affected by ACRS (the case where 100 percent of the inputs are expensible R&D) or is lower after ACRS. However, the required pre-tax return which must be earned by more traditional investments, ρ_T, has also been reduced, indeed has been reduced proportionately more than has ρ_T. The net impact of ACRS therefore is a scale effect favorable to all investment projects using depreciable—i.e., both ρ_I and ρ_T are lower under ACRS—and a substitution effect which tends to favor non-R&D intensive investments. Because the qualitative impact of the substitution effect is the opposite of that resulting from the scale effect, the ultimate impact of ACRS on the share of total investment dollars allocated to R&D-intensive investments is ambiguous. Table 8 also illustrates the differing impacts of the TEFRA version of ACRS as opposed to the ERTA version. Specifically, both the scale and the substitution effects of TEFRA are more modest than those resulting from ERTA.

TABLE 9.—VALUE OF R&D CREDIT WHICH MAINTAINS THE RATIO OF ρ_I TO ρ_T BEFORE AND AFTER ACRS

	$(\delta_a=0.10)$		$(\delta_a=0.25)$	
	ERTA	TEFRA	ERTA	TEFRA
$\alpha=0.1$	0.22		0.11	
$\alpha=.4$	.08	0.01	.045	0.006
$\alpha=.8$	.07	.02	.035	.011
$\alpha=1.0$	.06	.03	.033	.014

Tax credits for R&D

The calculations presented above show only the indirect effects on the non-capital (Section 174) portion of R&D resulting from the enactment of ACRS. However, the non-capital portion is also directly affected by the new R&D tax credit, and therefore these calculations do not capture the full extent of recent tax policy changes on R&D.

Modeling the impact of the R&D tax credit in its current form is complicated by two factors. First, the R&D credit is temporary rather than permanent. Second, it is based on incremental rather than total R&D expenditures. Both the timing and the applicable expenditures factors must be considered in order to access the impact of the R&D tax credit. In light of the recent emphasis on distinguishing between permanent and temporary policy changes, it is useful to organize the discussion around this distinction. Thus, we first examine the impact of enacting a permanent non-incremental tax credit for R&D, and then consider the impact of making such a tax credit temporary.

Permanent R&D tax credit

Equation (11) defines the pre-tax return, $_R$,required to earn after-tax real return, r, when both expensing is allowed and an investment qualifies for a tax credit of v percent;

$$(11) \qquad \hat{R} = r - \frac{v(r=\delta)}{(1-u)}$$

Equation (11) implies that combining a tax credit with expensing is tantamount to providing a rate of return subsidy equal to $v(r+\delta)/(1-u)$. Substituting $\hat{R}$ for the term $\alpha\ r/1-e)$ in equation (6) yields:

$$(12)\quad \delta=\alpha r-\alpha\left[\frac{v(r+\delta_{\alpha})}{(1-u)}\right]+(1-\alpha R,\ \text{or}$$

$$(13)\quad \delta=\alpha r+(1\text{-}\alpha)R-\frac{\alpha v(r+\delta_{\alpha})}{(1-u)}\ ,$$

where μ is the statutory marginal tax rate, δ_{α} is the economic depreciation rate of the expensible portion α of the investment, and R is the pre-tax return to the non-expensible portion $(1-\alpha)$. Equation (13) defines the pre-tax return required to earn a real after-tax return, r, when the portion of an investment project which can be expensed, α, also qualifies for a tax credit of v percent.

Two main conclusions can be drawn from (13). First, while extending a tax credit will generally lower ρ, a given credit of v will reduce ρ more the greater is the value of α. The greater the value of α, the greater is the share of the expensible asset in the investment project. Because the R&D credit is essentially limited to expenditures which also qualify for expensing under Section 174, such a credit would favor investment projects (i.e. lower ρ more) the greater the share of Section 174 R&D in total project costs. Section 174 includes only labor and other variable R&D inputs, and therefore the current R&D credit favors labor-intensive R&D, and more generally, innovation activities in which labor intensive R&D is a relatively important input.[7] Second, the greater is the value of δ_a, the more a given credit of v will reduce ρ. Moreover, the greater is the value δ_a, the more rapid is the rate at which an asset depreciates. Hence, (13) shows that a permanent R&D tax credit will favor both shorter-lived R&D, and innovation projects which are relatively dependent on short-lived R&D as an input.[8] Of course, other tax structures can have a similar effect. In fact, as equation (13) shows, the greater the value of δ_a, the more a given corporate tax rate, μ, will reduce ρ. In effect, any tax system which introduces a subsidy will have similar effect on ρ.

Temporary R&D tax credit

Enacting a permanent tax credit for R&D stimulates R&D spending in two distinct ways. First, as shown in (11), by reducing R such a credit encourages firms to substitute investments in R&D for other investments in every period subsequent to enactment of the credit. Second, by subsidizing one of the firm's inputs, such a credit would have a wealth effect which would encourage the firm to purchase more of all capital inputs, including R&D in every period subsequent to enactment of the credit.

These impacts may be compared with those of a credit which, say, was enacted to take effect at time t, and then was scheduled to expire at time t+1. Such a credit would still encourage firms to substitute R&D for other investments at time t. However, because R&D would be subsidized in time t, but not time t+1, firms would also have an incentive to substitute R&D undertaken in time t for R&D undertaken in subsequent periods. This incentive for intertemporal substitution would be stronger the longer-lived the R&D. The reason is straightforward. The slower the rate at which a unit of R&D depreciates, the more productive a unit of R&D purchased at time t will be subsequent periods. In the limiting case in which a unit of R&D did not depreciate at all, a unit of R&D purchased at time t would be a perfect intertemporal substitute for a unit of R&D purchased at time t+1 insofar as its ability to temporal substitute for a unit of R&D purchased at time t+1 insofar as its ability to contribute to the firm's output was concerned. In such a case, a decline in the price of R&D conducted at time t relative to R&D conducted at time t+1 would provide considerable encouragement to the firm to buy more R&D than otherwise desired at time t, and then "stockpile" such R&D for future use at time t+1.

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[7] The total amount of R&D could still increase, even if the share of R&D in total capital outlays decreased.

[8] This is a standard result in the literature on the economic effects of investment tax credits and is not unique to the R&D credit. The point is also recognized by Gravelle (1981).

The wealth effects of a temporary tax credit would also differ from those of a permanent credit. Specifically, because of its limited duration, a temporary tax credit would have a smaller wealth effect than would a permanent tax credit.

Because both the substitution and the wealth effects of a temporary tax credit differ from those of a permanent credit, the observed impact at time t on both the level and composition of R&D spending of a temporary tax credit can be quite different from the impact which would obtain if the tax credit were permanent. Specifically, because of the intertemporal substitution effect, a temporary tax credit would result in a greater increase in total R&D spending at time t than would a permanent tax credit. However, this impact would be offset by the fact that a temporary credit has a smaller wealth effect than does a permanent credit. Depending on the strength of these offsetting biases, the change in R&D spending at time t due to a temporary credit could either over- or understate the impact of a permanent credit. Furthermore, a greater share of whatever increase actually occurred would be in the form of longer- rather than shorter-lived R&D.

Finally, it should be emphasized that precisely because of its ephemeral character, a temporary tax credit is likely to have no long-lasting or permanent impact on either the long-run level or the long-run composition of R&D spending. Increases in the level of R&D spending at time t which were the result of intertemporal substitution would displace R&D which would have been done in subsequent periods. That is, extra R&D done at time t would reduce the need to conduct some R&D at time t+1, t+2, and so forth. Hence, any changes occurring at time t would be offset by opposite changes occurring in later periods. Thus, a temporary tax credit would have virtually no effect in present value terms on either the level or the composition of R&D spending. In essence such a credit would affect when certain R&D spending was undertaken (i.e., sooner rather than later), but not whether such spending was undertaken.[9]

Incremental R&D credits

Because the current tax credit is incremental, the amount of the credit in any given year is a function of R&D spending in prior years. This implies that any additional R&D spending undertaken at time t will increase the base which must be exceeded in order to qualify for the credit at time t+1. This in turn reduces the stimulative impact of the credit at time t. However, this consideration does not apply if the credit expires at time t+1. Thus, the temporary impact of the credit is likely to be the greatest in the year prior to its scheduled expiration date.[10] Moreover, while relatively little is known about the actual incentive effects of the current incremental R&D tax credit, research completed to date strongly suggests: (a) that the credit can actually have perverse effects on R&D spending in some realistic cases, and (b) that the added complexities and uncertainties of the credit have not necessarily resulted in better "targeting" of R&D incentives to appropriate industrial sectors.[11]

R&D credit and ACRS combined

As indicated by the foregoing discussion, how one assesses the combined impact of the R&D credit and ACRS depends on whether one expects the R&D tax credit to become a permanent feature of the U.S. tax code. If the R&D credit becomes permanent, its tendency to favor labor-intensive R&D will offset the incentive effect of ACRS which is to favor capital-intensive R&D. Moreover, the tendency of a permanent R&D credit to favor short-lived R&D would constitute a new incentive created by Federal tax policy. Indeed, this particular impact of the R&D tax credit stands in sharp contrast to that resulting from expensing of R&D: neutral treatment of R&D regardless of its decay rate. If, however, the R&D credit expires as scheduled in 1985, the change in relative incentives resulting from the recent tax changes would be of the sort shown in Table 8: i.e., scale effects favorable to all investments combined with modest substitition effects which are relatively unfavorable to R&D.

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[9] This entire discussion assumes that investment behavior by firms is reversed if a tax incentive is removed. Possibly, behavior is not precisely reversible. For example, a substitution effect due to a tax incentive which results in more R&D being conducted may result in permanent shifts in strategies by at least some firms as they experience higher rates of return from more innovation-oriented investment patterns. There is some evidence that strategies in technology-based industries, once established, persist for extended periods of time. Thus, if a temporary tax credit had a sufficiently strong demonstration effect in terms of revealing the possibility of higher rates of return from more R&D relative to other areas of investment, a strategy shift might occur. See Tassey (1983).

[10] See Gravelle (1981) for a detailed analysis of this issue.

[11] On the first point, see Eisner, et al. (1983). On the second, see Barth, Cordes, and Tassey (1984).

In light of the above findings, it is of some interest to ascertain what the approximate rate of a permanent but non-incremental credit would have to be under ACRS in order to maintain the same pattern of relative incentives, as measured by the ratio ρ_I/ρ_T. This can be done using expressions (13) and (10). Because these estimates are sensitive to the assumed decay rate for R&D, we present calculations for two different valves of δ_a, .10 and .25, which have been used or estimated in other studies. These estimates are presented in Table 9.

It is instructive to compare the values of v in Table 9 with the value of v which would result if the current incremental credit were to be replaced by a permanent, non-incremental credit of equal cost in terms of foregone tax revenues. Collins (1983) has recently presented calculations which would imply that the current 25 percent incremental credit will have a revenue impact equivalent to a non-incremental credit of between 4 and 12.5 percent. The noteworthy feature of this range is that it is well above the values of v which would be required under TEFRA (though not necessarily ERTA) to maintain the relative position of R&D. Thus if a non-incremental R&D credit were to be made a permanent feature of the tax code along with ACRS, the net impact would be a set of substitution effects basically favorable to R&D spending. However, the strength of these substitution effects would vary among different types of R&D. For example, Table 9 shows quite clearly that an R&D tax credit extended at a uniform rate would result in substitution effects which were more favorable for short-lived ($\delta_a = .25$) than for long-lived R&D ($\delta_a = .10$).

5. SUMMARY AND CONCLUSIONS

In this paper we have examined how the 1981 and 1982 changes in tax law have affected the incentives provided to U.S. industry for investment in technological change. Because a range of tax incentives can directly and indirectly affect technology-based economic activity, an integrated analysis of tax policy options is required. That is, because the existing direct incentives provided for, say, R&D can be altered by the indirect effects of incentives targeted toward other stages of economic activity, such as capital formation, it is important to consider both the substitution and the scale effects of tax policy. The main conclusions of this analysis may be summarized as follows:

(1) The investment incentives provided by the Accelerated Cost Recovery System will benefit all industries, however the incentives will be greater for some industries than others. This would have been particularly true for the version of ACRS enacted in ERTA. Changes to ACRS enacted in TEFRA will reduce, though not eliminate these differential incentives. The work of both Schmookler (1968) and Scherer (1981) suggest that these differential incentives should induce differential rates of increased innovation in capital goods supplied to U.S. industries.

(2) R&D activities, along with other industrial activities which use depreciable capital inputs, will share in the potential investment tax incentives provided by ACRS. The impact of these incentives on the composition of industrial R&D will depend on: (a) the distribution of R&D capital intensity among industries, and (b) the distribution among industries of the investment incentives from ACRS. Our analysis suggests that there is no systematic tendency for ACRS investment incentives to be the strongest in the case of industries with capital-intensive R&D.

(3) The only provision of ACRS pertaining specifically to depreciable assets used in R&D is the assignment of all R&D equipment to the 3-year recovery class, regardless of the useful life of such equipment under ACRS. Though this provision permits R&D equipment to be written off more rapidly than other equipment, it also reduces the investment credit for R&D equipment. Our analysis indicates that this provision was actually unfavorable to R&D equipment under the ERTA version of ACRS, but not under the TEFRA version. Indeed, due to the changes made in TEFRA, it now appears that R&D equipment is treated as well or somewhat better than non-R&D equipment.

(4) Empirical evidence from other research on whether there is a significant, positive relationship between R&D and cash flows is mixed. However, if such a relationship exists, our results imply that the cash flow benefits of ACRS will not tend to favor R&D-intensive industries.

(5) In the absence of the R&D tax credit, the substitution effects of ACRS tend to be unfavorable toward R&D-intensive investments. This tendency is the strongest under the ERTA version of ACRS, but is considerably weaker as a result of the changes enacted as part of TEFRA.

(6) Partly because of the changes enacted in TEFRA, the combination of (a) a permanent, non-incremental R&D tax credit equal in scope to the current temporary, incremental credit and (b) ACRS would result in substitution effects which favor R&D spending generally, though certain forms of R&D would benefit more than others.

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Chairman RANGEL. Thank you very much.

Mr. Kenneth Brown from the American Enterprise Institute for Public Policy Research.

STATEMENT OF KENNETH M. BROWN, VISITING FELLOW, AMERICAN ENTERPRISE INSTITUTE FOR PUBLIC POLICY RESEARCH

Mr. BROWN. Thank you very much, Mr. Chairman. Thank you for inviting me to testify today.

My name is Kenneth Brown and I am an economist with the American Enterprise Institute. The views I am going to give you today are my own. They do not reflect those of the AEI or anybody else.

I wrote an article on the R&D tax credit that appeared in Regulation magazine, and so today I am going to try to be very brief and just make one very basic point that I believe Congress should keep in mind. Now, the tax credit has been in effect for just over 3 years. It was viewed as something of an experiment, so that Congress could figure out whether or not it was working before they tried to extend it.

In fact, I notice that most of your questions today, Mr. Chairman, asked witnesses what this particular tax credit actually accomplished, if anything? Certainly the picture that has emerged from various studies has been one of mixed success. Clearly, the tax credit has stimulated some additional research, but the question still remains, was it worth all the money it cost the Treasury?

Here is my basic point, Mr. Chairman. The inconclusive record on the tax credit does not mean that tax credits for R&D are inherently inefficient. Any lack of effectiveness is related to flaws in this particular credit, and these are flaws that I believe could be corrected. In other words, Mr. Chairman, the choice Congress faces is not just whether to kill this credit or extend it, but rather whether to sit down before it expires and try to figure out how to improve it.

Now, what are the real flaws with this tax credit? A lot of this has been mentioned by Professor Eisner. I agree with most of the analysis, so I will be brief.

First, we have this mysterious shifting base, so that every time a firm increases its spending on R&D it does get a credit, all right, but at the same time it makes it harder to learn a credit in future years. My calculations show that in normal conditions you might reduce the tax credit to something like 5 percent instead of 25 percent, or it might even melt away to nothing. So it is no wonder that some firms did not increase their R&D very much.

The second big problem with this tax credit is that it is temporary rather than permanent, and with R&D in particular with R&D that is very important. R&D, Mr. Chairman, is a very long-run proposition. Any company that makes a serious effort in R&D has to plan the effort, it has to hire people, it has to get a research team together, and the research itself takes several years. The whole research effort may take many years.

So I cannot blame any firm for not jumping at a temporary credit. As one research manager told me—what the Government giveth, the Government can taketh away, so I am not going to change my plans very much to take advantage of this tax credit because it is not permanent.

Chairman RANGEL. There is no such thing as permanent.

Mr. BROWN. Well, there are degrees, Mr. Chairman. For example, consider the investment tax credit back in the late fifties, early sixties, that was put on, then taken off, then put on, and finally made permanent. In its early days when it was yo-yoed back and forth it had much less effectiveness than it did when it was made permanent.

So there are degrees of permanence, and if firms can be reasonably sure that the tax credit will keep going then they will be more reponsive to its incentives. But right now it is in the legislation that it is definitely going to be out of commission unless Congress takes particular action.

Chairman RANGEL. And you do not attach any significance at all to the fact that maybe people have to come forward, at some point, and show its worth, its value, and its benefits? You know, we make the provision permanent, we lock it in, and you know, we still change the permanent law every year at least we have for the last 4 years.

Mr. BROWN. Well, maybe this, sir, gets back to your questions to other witnesses, how do you know whether the firms have actually engaged in R&D? And I think there are a lot of things in economics, or indeed sprinkled all through the budget, where it is awfully hard to figure out what they are doing.

For example, HUD, I understand has just decided to engage in some housing grants, vouchers to people to pay for their housing. Ten years ago I worked on experiments with HUD in which HUD spent hundreds of millions of dollars experimenting, and they never did get a good answer to the question, exactly how much more money is going to be spent on housing. And yet, I think they still learned enough to say it is a reasonable sort of way to help people with their housing expenses.

Chairman RANGEL. But are you concluding that this is the best route to target funds for research and experimentation? That it should be through the tax system, and more specifically, it should be in the form of a tax credit?

Mr. BROWN. Yes, Mr. Chairman. I certainly would not go the route of direct subsidies. That has been tried in other countries and their research and development efforts are behind ours in this country.

Chairman RANGEL. I just do not see how we would ever get answers to the questions I have been asking. If you make this a permanent part of the law, then industry would know that a certain part is going to be written off. And quite frankly—well, anyway, I am certain we will be getting—when industry comes, they will tell us how to do it.

Mr. BROWN. Well, I will just be very brief and finish, if I may. The third problem has been the definition of research and experimentation. I have looked at what the Senate has done and I think that is quite a great improvement over the definition that is in effect right now.

So what to do about these problems? The definition I think can be substantially cleaned up. I believe—more than most of the other witnesses—that the permanence question is important, that if you do want to go with the tax credit then it should be permanent. I question the wisdom of extending a temporary tax credit. I do not think you will learn much about anything from that, because the permanence issue is so important. Not only would a temporary credit continue to be relatively ineffective, it would provide little useful evidence about the effectiveness of a permanent credit.

And finally, I agree with Professor Eisner about what to do about this mysterious shifting base. What you should do is make the firm's base independent of its own action. If you hook it onto the R&D spending by the whole industry or by the whole economy or make it something akin to the firm's growth in sales, any of these things would be better than what you have now. My written statement discusses this.

Well, in closing I just want to say I think as a taxpayer and a citizen I find it very encouraging that the Congress is taking so much time to deal with the high-tech issues, because as we recover from this recession it is clear that the high-tech industries are becoming more and more important.

Exports, jobs, economic growth, are all a part of high-tech industries performance. Every time we export some high-good commodity you can be sure that that is somehow the result of research and development that someone had done 5, 10, or even 15 years ago. So I am glad for that reason the committee is giving careful consideration to R&D tax policy, and I thank you very much for listening to my views.

[The prepared statement follows:]

STATEMENT OF KENNETH M. BROWN, VISITING FELLOW, AMERICAN ENTERPRISE INSTITUTE FOR PUBLIC POLICY RESEARCH

Mr. Chairman, thank you for inviting me to testify today. I am a professional economist and a visiting fellow at the American Enterprise Institute for Public Policy Research. The views that I will express are my own. They do not reflect those of AEI or any other organization.

My article in the January/February 1984 issue of Regulation, "The Ellusive Carrot: Tax Incentives R&D", presented my analysis of the tax credit for research and development. Today I wish to make just one basic point that I believe Congress should keep in mind when considering whether to extend or modify the existing provisions of the tax code.

The tax credit for R&D has been in effect for just over three years. It was viewed as something of an experiment, the thought being that experience gained by this time would indicate whether the credit should be made permanent. The National Science Foundation commissioned evaluative research by Professor Robert Eisner and by Professor Edwin Mansfield, and this Committee has requested a report by the General Accounting Office.

The picture that has emerged from these and other studies is one of mixed success. Clearly the tax credit has stimulated some additional research activity, but the question has been raised—particularly in the work by Mansfield—as to whether the additional R&D has exceeded the cost to the Treasury in lost revenue.

Here is my basic point: The inconclusive record of the tax credit during the first two or three years of its existence does not mean that a tax credit for R&D is inherently inefficient. Rather, any lack of effectiveness is related to flaws that could be corrected.

In other words, Mr. Chairman, the choice that faces Congress is not simply whether to extend the existing credit or let it lapse. Improvements are possible and are certainly worthy of consideration by Congress.

The formula for the tax credit has three main problems, all of which could be significantly reduced.

First, the tax credit formula (in particular the shifting "base") greatly reduces the effective value of the credit to the typical firm.

The company gets a tax credit equal to 25 percent of its R&D "base". The base is defined as the average of the firm's R&D spending for the previous three years. The problem is that when the firm raises its R&D spending this automatically raises its base for each of the next three years. It gets a credit this year, but it reduces its potential credit for each of the next three years. The net effect is that the value of the credit is not 25 percent of additional R&D but something much less. Depending upon circumstances that vary from firm to firm, the actual value of the credit may be around five percent of the extra R&D spending.

Second, any temporary tax credit is bound to be less effective than a permanent tax credit. With research and development, the reduction in effectiveness is likely to be particularly great.

The effectiveness of a tax credit depends upon the extent to which it entices taxpayers to change their behavior. Changing behavior takes time, and with industrial research the lag may be quite long. Research requires a long-term commitment by the firm. Scientists and technicians must be recruited, equipment must be acquired (and maybe designed first) and put into place, and work of uncertain duration must be planned. R&D effort must be sustained for years before it will pay off. While the temporary credit we now have on the books stimulated some increases in existing R&D programs, it is highly unlikely that any company mounted a significant new research program from scratch, for it faced the risk that the R&D credit would expire before the new program had gotten into full swing.

An R&D manager of a firm with a research budget of half a billion dollars told me that he was reluctant to greatly increase his budget on the strength of his faith that the credit would be made permanent. In his words, "What the Government giveth, the Government can taketh away."

In similar fashion, the investment tax credit had much less effect on business decisions back in the days when it was viewed as an instrument of economic fine-tuning and was turned off and was unpredictably.

In sum, a temporary credit is bound to be less effective than a permanent one. But our experience to date, and all of the existing empirical research, applies to a temporary credit that has been in effect for a very short time.

Third, the definition of "research and experimentation" was somewhat too broad, with the result that firms were able to claim as R&D some activities that were not really what Congress had intended to support.

What could be done to solve these problems?

The "permanence" problem is easy. If Congress wants to use the tax code to stimulate industrial R&D, it should enact a permanent credit, not one with an expiration date.

The question of how to tighten the definition of "research and experimentation" is not so easy, but it has been addressed by the Treasury Department in its testimony before the Senate Finance Committee.

The first point I raised—the peculiar shifting base—requires careful consideration. The basic solution to this problem is to change the formula to make the firm's base independent of its own R&D spending. Then the tax credit would work out to a true percent "discount" on incremental R&D.

There are several ways to do this. One would be to start with the base R&D figures that will apply to the 1985 tax year, i.e., the average R&D spending of 1982, 1983, and 1984. This base could, in future years, be changed by a simple adjustment factor such as the percentage increase in R&D spending (not adjusted for inflation) for industry as a whole. That is, each firm's base would be increased by whatever precentage change was observed for industrial R&D spending in the aggregate. These figures are readily available from the Science Foundation.

This formula might be considered too harsh, in that the base might rise so rapidly as to shut out slow-growing firms from benefits. Also, in case of an economy-wide slowdown in R&D spending, as all but the firms with the fastest growing R&D budgets might find their spending to be under the base. (This is also true of the existing formula). One way around this problem is to reduce the growth of the base by figuring the adjustment factor as in the previous paragraph but then multiplying it by, say, .75.

Another approach would be to construct the adjustment factror by reference to each firm's growth in sales. This would accomplish the goal of making the firm's base independent of its own R&D spending, as in the previous case, but would skew tax benefits more toward the slow-growing firms with slower-growing R&D budgets. Which approach is a matter of policy.

Clearly there are other approaches to the problem. All of them, however, require careful evaluation so that Congress is fully informed of their implications.

In closing, I wish to say just a few words about the importance of establishing a healthful atmosphere for industrial innovation. During the current economic recovery, it is clear that the high-tech industries are leading the way and are becoming ever more central to the success of our economy. These industries—computers, telecommunications, biotechnology, new materials, office automation, robotics, electronics, aerospace—achieved their success in large part because of the expenditures on research and development that were made in years past.

It is equally clear that the nations where innovation has trailed ours (and Japan's) are not going to keep up with our growth. The German economy is a prime example.

But we can't take the current boom in R&D spending for granted. Industrial spending for research slumped in the late 1960's and the early 1970s, and it could do so again. As this Committee considers the R&D tax credit—and the broader proposals for tax reform that will surface during the next session of Congress—I hope that it will pay particular attention to the implications of tax policy for industrial innovation. Thank you.

Chairman RANGEL. Thank you, Mr. Brown. What groups constitute the American Enterprise Institute?

Mr. BROWN. The American Enterprise Institute is an independent nonprofit organization, and our mission is to encourage public policy research.

The AEI doesn't take any position on any kind of issue. Our scholars and fellows come forth with their own views and often disagree with each other.

Chairman RANGEL. But you basically support research, experimentation and development in that area?

Mr. BROWN. That is my particular view. But the American Enterprise Institute does not have any view one way or the other. Our mission at AEI is to put out policy research that is useful to Congress and other decisionmakers.

Chairman RANGEL. But in that research, you support federally subsidized research?

Mr. BROWN. Well, we do not spend any money on the Federal Government, and receive very little money from the Federal Government. I support the concept of federally subsidized research, but in a limited way. These are some things the Government should not interfere with.

Chairman RANGEL. You kept citing Dr. Eisner and I got the impression from his testimony that he did not think this was the route to go. He was merely trying to say that, if we decided that we were going to continue this type of subsidy through the tax laws, then you two agree on how that should happen.

Mr. BROWN. I cannot speak for Professor Eisner, but I think I am much more favorably disposed to working with this tax credit and coming up with something that would be a reasonable alternative to the existing formula.

Chairman RANGEL. And he thinks an alternative might be better than the tax.

Mr. **Brown**. I believe the Government should support some basic research, but industrial R&D is best left to the market, with only indirect support such as by tax benefits. The Government should not be in the business of choosing among research projects in the private sector.

Chairman **Rangel**. You are supporting the concept of a direct subsidy?

Mr. **Eisner**. Yes, I would support the subsidy rather than a tax credit, and I am a bit surprised that that could be seen as the same thing as a credit. But it still leaves the individual firm the decision to make in what subsidy it has, although I think I might prefer to that a more direct approach still, such as we have in the way of defense and agriculture, or direct support of research institutes and universities and support for basic science, basic research, and leave businesses free to spend as much as they like on applied research, given their expected profitability.

Chairman **Rangel**. Thank you.

Now, Dr. David Braverman, associate economist from McGraw-Hill Economics, New York.

STATEMENT OF DAVID J. BRAVERMAN, ASSOCIATE ECONOMIST, McGRAW-HILL ECONOMICS

Mr. **Braverman**. Thank you, Mr. Chairman. Good afternoon.

As you know, I am an economist with McGraw-Hill Economics. For the last 29 years, our organization has conducted an annual survey measuring business plans, research and development spending. Over 300 companies traditionally respond to this survey.

This year the survey found that companies plan to increase their spending by 8.3 percent in 1984. This is the fifth consecutive year that the growth rate in R&D spending has declined. In 1983 we estimate that R&D expenditures grew by 11.1 percent. In 1980, before the credit took effect, expenditures grew by 16.4 percent. Thus, R&D spending continues to grow each year, though at a decreasing rate.

This decline in R&D growth has occurred in spite of the strong economic recovery and in spite of an ambitious tax credit program designed to encourage R&D spending. There are a couple of reasons for R&D expenditures to have grown at a rate slower than expected.

First, the tax credit is ineffective to companies that cut their spending in 1982, when we were still in a recession. In many cases, even if these companies substantially increase their R&D spending, the 3-year base is still above the current year spending, causing no credit to be allowed. Many companies in the iron and steel industry are good examples of this.

Also, companies in the startup phase have very little tax liability and thus are unable to use the credit until they have some tax liability. In addition, many companies still have not implemented the most current technologies in their manufacturing operations and can see no reason to try to discover any newer technologies until their factories have been modernized.

Therefore, while encouraging R&D is a good idea, we think business would be better served by reducing interest rates and reducing budget deficits, rather than subsidizing R&D, since most firms taking the credit already enjoy a high rate of return from their research expenditures.

That concludes a summary of my prepared statement. I have submitted a full copy of our survey results, along with historical data for the record, and I will be happy to try to answer any questions you might have.

[The prepared statement follows:]

STATEMENT OF DAVID J. BRAVERMAN, ASSOCIATE ECONOMIST, McGRAW-HILL ECONOMICS

Good morning, My name is David Braverman. I am an economist with McGraw-Hill Economics. For the last 29 years, our organization has conducted an annual survey measuring business plans for research and development spending. Over 300 companies traditionally respond to the survey. This year, the survey found that companies plan to increase their spending by 8.3% in 1984. This is the fifth consecutive year that the growth rate in R&D spending has declined. In 1983, we estimate that R&D expenditures grew by 11.1%. In 1980 expenditures grew by 16.4%. Thus, R&D spending continues to grow each year, though at a decreasing rate.

This decline in growth, has occurred in spite of a strong economic recovery, and in spite of an ambitious tax credit program designed to encourage R&D spending. There are a couple of reasons for R&D expenditures to have grown at a rate slower than expected. First, the tax credit is ineffective to companies that cut their spending in 1982, when we were still in a recession. In many cases, even if these companies substantially increased their R&D spending, the three year base is still above the current year's spending, causing no credit to be allowed. Many companies in the iron and steel industry are good examples of this.

In addition, many companies still have not implemented the most current technologies in their manufacturing operations and can see no reason to try to discover any newer technologies until their factories have been modernized.

Therefore, we see a higher priority in reducing interest rates and in reducing budget deficits than in subidizing R&D, since most firms already enjoy a high rate of return from their research expenditures.

29TH ANNUAL McGRAW-HILL SURVEY OF BUSINESS' PLANS FOR RESEARCH AND DEVELOPMENT EXPENDITURES, 1984-87

In spite of large gains in both corporate profits and capital spending, research and development (R&D) spending in the U.S. will increase at a slower rate than last year.

R&D outlays are pegged to rise 8.3% in 1984 to $71 billion. That advance is slower than the 11.1% increase recorded last year and well beneath the 16% annual gain reached in 1981.

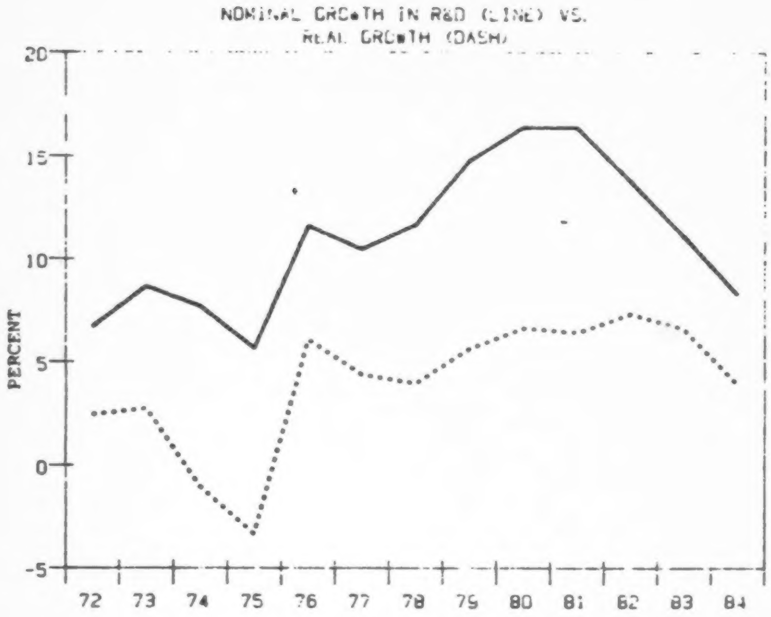
These are highlights of McGraw-Hill's annual survey of business' R&D plans, conducted in March and April. Survey results are based on responses from more than 300 companies, but figures in this report are adjusted to represent spending by all U.S. firms.

The survey results indicate an unwillingness by business to increase the pace of R&D spending until more progress is made in modernizing and expanding plant and equipment. Currently, a large percentage of corporate funds are being funneled into such projects, suggesting that firms want to fully utilize current technologies before stressing development of new ones.

One reason to be more optimistic about 1984 R&D spending can be found in last year's survey results. A year ago, survey respondents expected to increase 1983 spending 8.2%. However, once the economic recovery got into full swing, 1983 R&D expenditures ended up rising 11.1%. Thus the possibility again exists that further expansion of corporate profits and cash flow could lead to larger increases in 1984 R&D spending than the survey suggests.

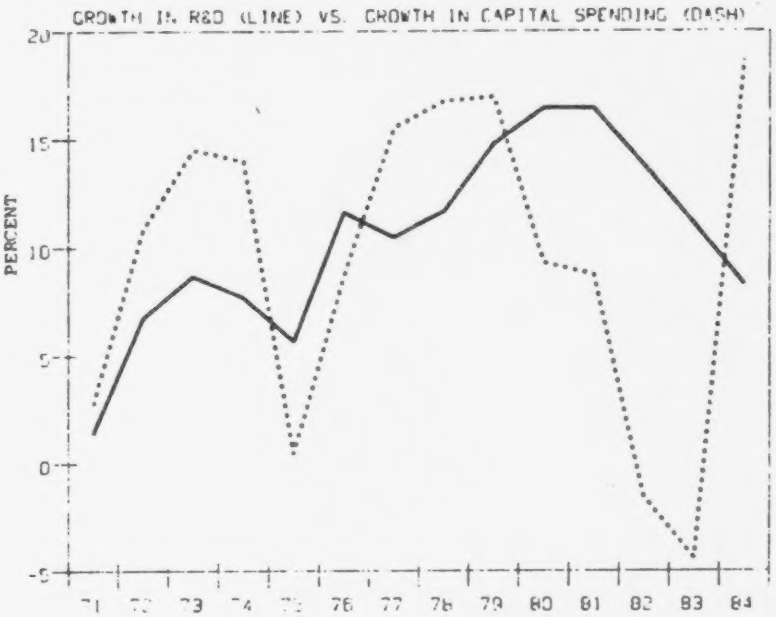
A second reason that the survey results can be looked at in a favorable light is that inflation continues to be lower than it was several years ago. Therefore, once the data is adjusted for smaller price increases, the R&D slowdown is much less severe. In 1984, inflation will probably be in the 4%-5% range. Chart I shows the growth in R&D spending both before and after the inflation adjustment.

CHART I



However, compared to other business spending this year, R&D growth is comparatively weak. According to the latest McGraw-Hill capital spending survey, for example, expenditures on plant and equipment will rise 18.6% in 1984, compared to just 8.3% for R&D. Therefore, for the first time in four years, R&D expenditures will fall as a percent of capital spending (Table V). But that is typical in an economic expansion, as shown in Chart II. By the same token, R&D spending usually outpaces fixed investment during recession and early recovery, as also shown in Chart II. For example, in 1983 R&D spending was up 11.1%. At the same time, capital expenditures fell close to 3%.

CHART II



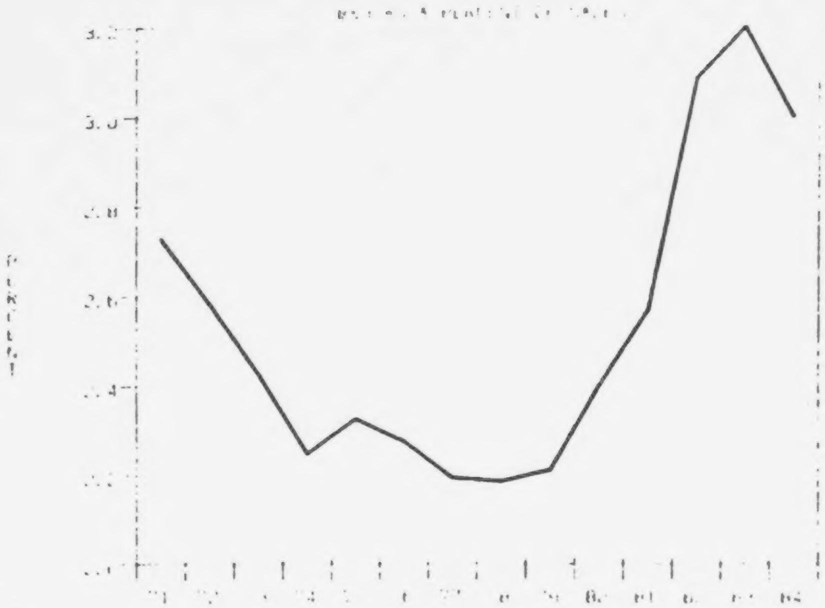
One possible explanation for the relative decline in R&D expenditures is that firms maintained an extremely high level of spending through the recession and are now using large amounts of capital spending to reap the benefits of their R&D. For example, in the autos, trucks, and parts industry, plans for R&D spending are up only 5%. In contrast, the auto industry is hiking capital expenditures by 56.1%. The reason? Automotive capital expenditures are being used to improve and modernize factories in ways discovered by previous years' R&D expenditures. Specifically, through increased use of robotics, the auto makers are able to increase plant efficiency and lower production costs.

In addition, the automakers are reaping the benefits of their product R&D. Most of the capital spending going to auto industry expansion is slated to produce three models that represented a large R&D expense: Chrysler's garageable minivans, the Voyager and Caravan, GM's mid-engine sportscar, the Fiero, and Ford's aerodynamic front-wheel drive compact cars, the Tempo and Topaz.

This example holds true in most of the industries in 1984: Firms by and large are using this year to invest in existing technologies.

The auto industry example also shows that financial pressures are not holding back R&D spending. The automakers are enjoying a year that seems guaranteed to bring record sales and earnings. In fact, though many industries are recording excellent financial results, many companies are not using their additional earnings to fund rapid increases in R&D. This year, survey respondents expect R&D to total 3% of sales, down slightly from the 3.1% of sales in 1983. However, 3.1% is still a good performance when compared to previous years (Chart III).

CHART III



While many industries are planning slower growth in R&D, some industries are bucking the trend and are increasing R&D expenditures at an increasingly rapid rate. These are: rubber and plastics, instruments, fabricated metals, and nonferrous metals. In the case of instrumentation and rubber and plastics, research and development is an integral part of their operations, since new products and new technologies are essential for revenue growth.

Most companies indicated a continuing commitment to R&D spending for the next three years, but also indicated there would be now further acceleration in spending growth. For the longer term, survey respondents said spending growth between 1984 and 1987 would remain about 9% on average. This reduced growth compared to the late 1970's and early 1980's primarily reflects 4%-5% R&D growth planned by the electrical machinery, petroleum, and auto industries. Rather than sharply increasing R&D further in the next few years, these industries may instead have decided to consolidate gains reaped through heavy R&D in recent years.

TABLE I.—RESEARCH AND DEVELOPMENT EXPENDITURES

[Dollar amounts in millions]

Industry	Estimated		Planned		Percent change	
	1982	1983	1984	1987	1983–84	1984–87
Iron and steel	$510	$452	$434	$454	−4.1	4.8
Nonferrous metals	325	307	350	450	13.9	28.7
Electrical machinery	11,925	14,310	15,240	17,443	6.5	14.5
Nonelectrical machinery	7,879	8,097	8,845	11,894	9.2	34.5
Autos, trucks and parts	4,962	5,782	6,071	7,044	5.0	16.0
Aerospace	14,045	16,385	17,923	24,479	9.4	36.6
Fabricated metals	570	636	717	910	12.7	26.9
Instruments	4,047	4,526	5,109	7,205	12.9	41.0
Stone, clay and glass	460	517	528	709	2.1	34.3
Chemicals	6,588	7,308	8,186	10,364	12.0	26.6
Paper and pulp	626	532	560	673	5.2	20.1
Rubber and plastic	888	1,491	1,691	2,349	13.4	38.9
Petroleum	2,248	2,213	2,265	2,573	2.3	13.6
Food and beverage	752	797	879	1,215	10.3	38.2
Textiles	129	142	149	177	4.7	19.2
Other manufacturing	838	952	1,004	1,177	5.4	17.2
All manufacturing	56,792	64,448	69,949	89,116	8.5	27.4
All nonmanufacturing	2,168	1,068	1,013	1,150	−5.1	13.5
All business	58,960	65,516	70,962	90,266	8.3	27.2

TABLE II.—*New product sales—1987*

[As a percent of total sales]

Industry:	*1987*
Iron and steel	13.7
Nonferrous metals	9.9
Electrical machinery	17.7
Nonelectrical machinery	41.9
Autos, trucks and parts	25.0
Aerospace	27.9
Fabricated metals	11.3
Instruments	27.4
Stone, clay and glass	30.5
Chemicals	8.8
Paper and pulp	2.5
Rubber and plastic	21.8
Petroleum	2.0
Food and beverage	14.2
Textiles	22.5
Other manufacturing	10.1
All manufacturing	18.5
All nonmanufacturing	1.7
All business	18.4

TABLE III.—PERCENT OF R&D EXPENDITURES GOING FOR NEW PRODUCTS, NEW PROCESSES, AND IMPROVEMENT OF EXISTING PRODUCTS

Industry	Actual 1983			Planned 1984			Planned 1985		
	New products	New processes	Improve existing products	New products	New processes	Improve existing products	New products	New processes	Improve existing products
Iron and steel	68	13	20	70	13	17	50	17	31
Nonferrous metals	24	21	55	31	22	47	35	22	43
Electrical machinery	63	15	22	63	15	22	56	18	26
Nonelectrical machinery	56	7	37	55	6	39	56	7	38
Autos, trucks and parts	20	12	68	53	11	35	51	13	36
Aerospace	33	32	34	36	32	33	35	31	34
Fabricated metals	47	16	37	47	16	37	47	15	37
Instruments	53	8	39	53	8	39	54	8	38
Stone, clay and glass	13	12	74	14	13	73	17	15	68
Chemicals	39	8	54	42	7	51	42	9	49
Paper and pulp	6	71	22	6	71	22	6	71	22
Rubber and plastic	41	8	51	40	9	51	41	12	47
Petroleum	19	29	53	15	35	49	5	2	93
Food and beverage	40	10	49	42	12	47	41	12	47
Textiles	24	16	60	23	16	60	26	15	60
Other manufacturing	73	15	12	74	12	14	77	13	10
All manufacturing	43	19	38	47	18	35	45	18	37
All nonmanufacturing	21	65	14	20	65	14	21	65	14
All business	43	20	37	46	21	33	43	20	37

TABLE IV.—RESEARCH AND DEVELOPMENT AS A PERCENT OF SALES

	1983	1984
Industry:		
Iron and steel	0.97	0.81
Nonferrous metals	.53	.52
Electrical machinery	9.14	8.97
Nonelectrical machinery	4.51	4.35
Autos, trucks and parts	3.79	2.99
Aerospace	23.31	21.85
Fabricated metals	.52	.52
Instruments	9.05	9.18
Stone, clay and glass	1.06	.98
Chemicals	3.84	3.92
Paper and pulp	.62	.58
Rubber and plastic	2.87	2.95
Petroleum	1.16	1.14
Food and beverage	.28	.28
Textiles	.27	.25
Other manufacturing	.28	.32
All manufacturing	3.14	3.04

TABLE V.—RESEARCH AND DEVELOPMENT AS A PERCENT OF CAPITAL SPENDING

	1983	1984
Industry:		
Iron and steel	15.23	9.68
Nonferrous metals	12.58	9.24
Electrical machinery	131.28	99.85
Nonelectrical machinery	65.56	57.36
Autos, trucks and parts	80.64	54.23
Aerospace	332.36	263.81
Fabricated metals	28.65	24.22
Instruments	180.33	167.35
Stone, clay and glass	21.10	15.09
Chemicals	55.03	52.97
Paper and pulp	8.61	8.40
Rubber and plastic	78.07	61.45
Petroleum	9.43	7.78
Food and beverage	12.07	11.73
Textiles	10.21	9.75
Other manufacturing	8.86	8.13
All manufacturing	57.79	49.31
All nonmanufacturing	2.15	1.85
All business	21.66	21.25

TABLE VI.—HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES

[Millions of dollars]

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary metals	$62	$69	$74	$90	$108	$131	$152	$177	$177	$171	$183
Iron and steel	42	44	46	55	64	80	84	102	98	97	106
Nonferrous metals	20	25	28	35	44	51	68	75	79	74	77
Machinery	330	358	455	543	669	781	930	949	901	914	958
Electrical machinery and communications	817	904	983	1,516	1,804	1,969	2,329	2,532	2,483	2,639	2,866
Radio and TV receiving equipment	(1)	()(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
Communications equipment and electrical components	74	141	200	575	748	868	1,162	1,324	1,404	1,591	1,773
Other electrical equipment	[2] 743	[2] 763	[2] 783	[2] 941	[2] 1,056	[2] 1,101	[2] 1,167	[2] 1,208	[2] 1,079	[2] 1,048	[2] 1,093
Aerospace	929	999	1,285	2,138	2,574	2,609	3,090	3,514	3,829	4,042	4,712
Autos and other transportation equipment	495	531	561	688	707	856	866	884	936	999	1,090
Fabricated metal products	52	55	65	116	135	162	138	145	136	146	153
Professional and scientific instrument	178	195	176	200	249	294	309	329	297	309	284
Scientific and mechanical measures	86	94	85	97	139	156	159	160	119	101	70
Optical, surgical and photo	92	101	91	103	110	138	150	169	178	208	214
Stone, clay and glass	40	45	46	60	69	75	81	88	88	96	100
Lumber and furniture	10	10	10	10	14	12	12	10	10	10	11
Chemicals	374	407	445	641	705	792	891	980	1,101	1,175	1,239
Industrial chemicals	269	289	315	460	503	553	600	666	706	738	809
Drugs and medicines	40	50	60	94	104	128	154	162	180	195	216
Other chemicals	65	68	70	87	98	111	137	152	215	242	214
Paper	29	33	32	36	35	42	49	56	59	65	69
Rubber	54	65	79	105	107	89	115	121	138	141	156
Petroleum	149	167	172	182	211	246	278	296	299	310	317
Food and beverages	54	61	70	64	74	83	91	104	125	121	130
Textiles and apparel	10	12	12	12	15	26	30	38	30	28	30
Other manufacturing	[3] 53	[3] 58	[3] 64	[3] 74	93	105	118	119	105	65	54
All manufacturing	[3] 3,536	[3] 3,969	[3] 4,529	[3] 6,475	7,569	8,272	9,479	10,341	10,714	11,230	12,354
All nonmanufacturing	[3] 94	[3] 101	[3] 111	[3] 130	162	117	139	168	194	234	276
All industry	3,630	4,070	4,640	6,605	7,731	8,389	9,618	10,509	10,908	11,464	12,630

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary metals	195	213	232	242	251	257	275	272	277	307	358

TABLE VI.—HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES—Continued

[Millions of dollars]

Iron and steel	116	128	139	135	135	136	149	144	147	163	181
Nonferrous metals	79	85	93	107	115	121	126	128	130	145	177
Machinery	1,015	1,065	1,217	1,326	1,483	1,546	1,729	1,860	2,158	2,549	2,985
Electrical machinery and communications	2,972	3,200	3,626	3,867	4,083	4,347	4,220	4,389	4,680	4,902	5,011
Radio and TV receiving equipment	(1)	(1)	47	45	55	57	70	64	48	49	51
Communications and electrical components	1,872	1,989	2,249	2,425	2,520	2,670	2,604	2,739	2,913	3,019	2,913
Other electrical equipment	[2] 1,100	[2] 1,211	1,330	1,397	1,508	1,620	1,546	1,586	1,719	1,834	2,047
Aerospace	5,078	5,148	5,526	5,669	5,765	5,878	5,219	4,881	4,950	5,052	5,278
Autos and other transportation equipment	1,182	1,230	1,344	1,354	1,499	1,568	1,591	1,768	2,010	2,477	2,476
Fabricated metal products	148	145	154	163	183	182	207	242	253	291	313
Professional and scientific instrument	331	403	468	542	663	742	744	746	838	961	1,075
Scientific and mechanical measure	74	80	87	104	118	123	131	133	163	186	221
Optical, surgical and photo	257	323	381	438	545	619	613	612	675	775	854
Stone, clay and glass	109	112	117	136	142	159	167	164	183	199	217
Lumber and furniture	12	11	12	12	20	18	52	53	64	71	84
Chemicals	1,284	1,356	1,407	1,507	1,589	1,660	1773	1,832	1,932	2,116	2,450
Industrial chemicals	865	908	918	966	981	1,007	1,031	1,009	1,031	1,119	1,299
Drugs and medicine	234	267	308	343	398	444	485	549	607	698	807
Other chemicals	185	181	181	198	210	209	257	274	294	299	344
Paper	77	94	117	128	144	188	178	187	189	194	237
Rubber	158	162	168	182	223	261	276	289	377	426	469
Petroleum	393	397	371	371	437	467	515	505	468	498	622
Food and beverages	144	157	164	183	184	199	230	240	259	269	298
Textiles and apparel	32	38	51	57	58	60	58	59	61	64	69
Other manfuacturing	65	71	77	90	101	121	128	131	146	158	177
All manufacturing	13,193	13,801	15,051	15,826	16,826	17,653	17,362	17,816	18,845	20,534	22,119
All nonmanufacturing	319	384	497	559	603	655	705	704	707	715	768
All industry	13,512	14,185	15,548	16,385	17,429	18,308	18,067	18,320	19,552	21,249	22,887

	1975	1976	1977	1978	1979	1980	1981
Primary metals	443	506	538	560	634	728	878
Iron and steel	215	256	284	314	375	443	487
Nonferrous metals	228	250	254	246	259	285	391
Machinery	3,196	3,487	3,880	4,283	4,825	5,901	6,818

Electrical machinery and communications	5,105	5,636	5,886	6,507	7,824	9,175	10,329
Radio and TV receiving equipment	50	52	96	130	245	556	572
Communications equipment and electrical components	2,934	3,202	3,495	3,901	4,804	5,571	6,331
Other electrical equipment	2,121	2,382	2,295	2,476	2,775	3,048	3,426
Aerospace	5,713	6,339	7,033	7,536	8,041	9,198	11,968
Autos and other transportation equipment	2,430	2,872	3,478	4,010	4,668	5,117	4,986
Fabricated metal products	324	358	386	384	455	550	624
Professional and scientific instrument	1,173	1,331	1,571	1,998	2,505	3,029	3,614
Scientific and mechanical measures	266	325	452	670	950	1,352	1,499
Optical, surgical and photo	907	1,007	1,119	1,328	1,555	1,677	2,115
Stone, clay and glass	233	263	287	324	356	406	467
Lumber and furniture	88	107	123	126	139	148	161
Chemicals	2,727	3,017	3,202	3,580	4,038	4,636	5,625
Industrial chemicals	1,391	1,524	1,668	1,798	1,962	2,197	2,802
Drugs and medicines	981	1,091	1,117	1,308	1,517	1,777	2,231
Other chemicals	354	401	417	474	559	662	592
Paper	249	313	333	387	445	495	566
Rubber	467	502	491	493	577	656	678
Petroleum	693	767	918	1,060	1,262	1,552	1,958
Food and beverages	335	355	415	472	528	620	641
Textiles and apparel	70	82	83	89	101	115	130
Other manufacturing	205	217	243	266	288	364	461
All manufacturing	23,452	26,152	28,867	32,075	36,686	42,690	49,904
All nonmanufacturing	735	845	958	1,229	1,540	1,815	1,906
All industry	24,187	26,997	29,825	33,304	38,226	44,505	51,810

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[1] Not available.
[2] Includes radio and TV.
[3] Estimated.

Source: National Science Foundation.

TABLE VII.—HISTORICAL RESEARCH & DEVELOPMENT EXPENDITURES AS A PERCENT OF CAPITAL INVESTMENT

[Percent]

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary metals	4.53	8.12	8.31	6.12	4.82	8.91	13.10	10.66	15.39	15.55	13.66
Iron and steel	4.47	7.46	6.97	5.34	4.71	8.08	10.37	7.61	11.40	12.76	12.05
Nonferrous metals	4.65	9.62	12.17	7.95	5.00	10.63	19.43	23.44	27.24	21.76	16.74
Machinery	41.77	51.88	56.17	50.28	52.27	84.89	91.18	78.43	81.17	72.54	77.26
Electrical machinery	151.30	177.25	189.04	207.67	243.78	339.48	328.03	248.24	236.48	266.57	280.98
Aerospace	552.67	666.00	558.70	577.84	559.57	931.79	1,030.00	1,033.53	1,276.33	1,010.50	1,079.91
Autos and other transportation equipment	36.67	30.00	36.91	31.85	45.32	73.16	64.15	55.25	63.24	63.23	56.48
Fabricated metals	11.82	11.96	12.50	18.13	19.57	30.57	22.26	24.17	26.15	24.75	22.17
Instruments	161.82	139.29	110.00	105.26	131.05	196.00	162.63	137.08	129.13	118.85	97.93
Stone, clay and glass	10.00	10.23	7.19	6.67	8.85	13.64	11.41	11.28	12.57	13.33	14.29
Chemicals	26.52	36.67	44.50	44.21	40.99	60.00	76.15	61.64	68.81	74.37	72.03
Paper	7.07	7.33	6.27	4.50	4.32	7.37	7.54	7.27	9.52	10.48	9.86
Rubber	22.50	32.50	32.92	31.82	32.42	40.45	41.07	35.59	38.33	37.11	40.00
Petroleum	5.19	5.74	5.62	5.26	5.48	9.04	10.00	10.24	10.07	10.06	10.23
Food and beverages	5.24	5.98	7.14	5.61	6.07	7.55	7.46	7.70	8.33	8.34	8.67
All manufacturing	28.45	33.08	36.23	39.65	43.25	63.73	68.89	63.21	68.99	70.06	71.53
All nonmanufacturing	.44	.48	.46	.46	.53	.40	.45	.52	.60	.66	.77
All industry	10.81	12.28	12.68	14.76	16.07	19.89	21.48	21.61	22.81	22.36	23.72
	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary metals	9.75	9.26	8.53	8.04	8.04	8.89	9.79	11.88	13.58	12.04	8.97
Iron and steel	8.06	8.05	8.08	7.11	6.72	7.43	9.14	11.34	13.74	13.04	9.33
Nonferrous metals	14.11	11.97	9.21	9.64	10.36	11.42	10.68	12.55	13.40	11.15	8.63
Machinery	63.04	47.54	41.82	43.91	51.14	42.59	45.74	59.05	66.81	64.21	57.07
Electrical machinery	254.02	189.35	144.46	123.55	129.21	132.94	120.92	144.85	165.37	140.06	130.16
Aerospace	1,238.54	971.32	472.31	453.52	468.70	455.66	593.07	774.76	727.94	580.69	349.54
Autos and other transportation equipment	44.27	38.32	39.07	42.45	49.64	44.67	42.20	60.76	53.89	51.71	46.28
Fabricated metals	17.41	16.86	13.51	12.64	13.46	13.58	16.97	20.17	17.69	16.08	16.13
Instruments	114.14	80.60	65.00	75.28	90.82	81.54	85.52	93.25	96.32	83.57	90.34
Stone, clay and glass	13.46	13.02	10.35	14.78	15.96	14.20	15.75	17.45	13.66	12.59	13.23
Chemicals	61.14	48.09	42.00	48.93	56.75	55.15	52.46	56.02	57.16	49.91	37.87
Paper	8.46	8.79	8.86	8.59	11.34	11.60	10.23	14.50	12.95	9.75	8.20

Rubber	33.62	27.46	25.85	27.16	23.23	24.39	30.00	36.58	36.60	27.48	29.87
Petroleum	11.20	10.23	8.28	7.67	8.81	8.88	9.98	9.69	9.77	10.64	8.51
Food and beverages	8.23	8.40	7.77	8.93	8.36	7.21	6.93	7.16	7.90	7.43	7.39
All manufacturing	62.14	54.31	47.89	49.07	52.03	48.67	46.94	52.43	53.20	48.46	41.57
All nonmanufacturing	.79	.85	.98	1.09	1.07	1.04	1.03	.94	.83	.75	.74
All industry	21.91	20.14	18.91	19.64	19.70	18.40	17.11	16.88	16.26	15.43	14.58

	1975	1976	1977	1978	1979	1980	1981	1982
Primary metals	8.54	10.10	11.52	12.10	11.57	11.38	13.24	13.51
Iron and steel	7.12	8.42	10.18	12.46	12.14	13.47	16.62	14.69
Nonferrous metals	10.51	12.69	13.51	11.66	10.84	9.16	10.14	11.99
Machinery	64.44	63.06	58.88	59.40	45.87	50.91	66.13	61.12
Electrical machinery	162.58	153.99	126.04	114.36	107.47	95.67	100.18	11.29
Aerospace	340.06	375.09	349.90	234.04	152.58	130.84	186.12	232.53
Autos and other transportation equipment	57.31	61.11	59.76	55.54	56.24	56.48	59.78	56.23
Fabricated metals	16.45	16.05	15.50	13.33	14.92	18.58	21.08	22.01
Instruments	110.66	117.79	116.37	125.66	142.33	132.85	53.78	72.21
Stone, clay and glass	14.04	14.06	12.81	10.45	9.04	10.63	14.87	12.62
Chemicals	35.74	37.16	39.34	42.31	37.46	36.79	41.36	67.27
Paper	8.36	10.06	9.25	9.70	8.02	7.28	8.42	10.49
Rubber	40.26	38.32	29.76	23.48	26.59	37.92	39.52	51.93
Petroleum	7.23	7.12	7.23	7.60	7.79	7.50	7.33	8.42
Food and beverages	8.33	7.40	8.11	7.91	7.98	8.39	8.28	9.72
All manufacturing	42.70	43.62	41.70	40.23	37.18	36.86	41.70	47.45
All nonmanufacturing	.72	.76	.74	.81	.90	1.01	.97	1.10
All industry	15.34	15.75	15.06	14.40	14.13	15.05	16.37	1863

TABLE VIII.—HISTORICAL RESEARCH AND DEVELOPMENT EXPENDITURES AS A PERCENT OF SALES

[Percent]

Industry	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963
Primary metals	0.26	0.34	0.28	0.29	0.35	0.49	0.48	0.57	0.57	0.53	0.53
Iron and steel	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nonferrous metals	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Machinery	1.35	1.60	1.88	1.91	2.26	2.95	2.89	2.80	2.60	2.51	2.44
Electrical machinery	4.45	5.60	5.51	7.77	9.01	10.26	10.34	10.75	9.68	9.27	9.60
Aerospace	6.84	8.87	11.17	16.80	17.31	19.90	20.27	24.12	25.43	24.24	26.38
Autos and other transportation equipment	1.99	2.61	2.09	2.90	2.75	4.31	3.54	3.34	3.44	3.52	3.43
Fabricated metals	.34	.37	.40	.54	.60	.76	.58	.61	.58	.58	.64
Instruments	4.74	5.45	4.53	4.68	5.40	6.30	6.18	6.70	6.29	6.81	6.92
Stone, clay, and glass	.56	.62	.53	.67	.81	.76	.71	.79	.79	.82	.81
Chemicals	1.99	2.14	2.08	2.82	3.01	3.50	3.44	3.76	4.12	4.08	3.97
Paper	.35	.38	.32	.34	.32	.38	.40	.44	44	.45	.46
Rubber	1.08	1.41	1.39	1.87	1.86	1.27	1.43	1.49	1.70	1.57	1.62
Petroleum	1.18	1.28	1.22	1.17	1.29	1.57	1.71	1.76	1.78	1.80	1.76
Food and beverages	.12	.13	.14	.13	.14	.16	.16	.18	.18	.18	.19
Textiles	.08	.10	.09	.09	.10	.16	.17	.22	.23	.21	.20
All manufacturing	1.26	1.49	1.57	2.06	2.31	2.53	2.61	2.79	2.89	2.81	2.94

Industry	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974
Primary metals	.50	.48	.48	.54	.52	.53	.58	.53	.47	.42	.37
Iron and steel	NA	NA	NA	NA	NA	.51	.59	.56	.51	.45	.36
Nonferrous metals	NA	NA	NA	NA	NA	.57	.57	.61	.54	.48	.47
Machinery	2.87	2.69	2.59	2.69	2.90	2.76	3.06	3.32	3.28	3.28	3.23
Electrical machinery	9.89	9.33	9.10	9.16	9.02	9.12	8.94	9.15	8.22	8.05	7.61
Aerospace	30.32	29.37	26.00	22.05	20.90	21.88	21.30	21.77	23.68	23.48	20.25
Autos and other transportation equipment	2.85	2.43	2.62	2.90	2.66	2.67	3.16	2.64	2.73	2.86	2.99
Fabricated metals	.51	.45	.42	.48	.41	.39	.45	.51	.47	.49	.46
Instruments	4.46	4.70	4.72	4.85	5.38	5.65	5.68	5.50	5.39	5.40	5.13
Stone, clay, and glass	.83	.79	.79	.93	.89	.93	.98	.87	.85	.83	.82
Chemicals	3.82	3.69	3.52	3.64	3.54	3.50	3.65	3.60	3.37	3.32	2.92
Paper	.45	.51	.57	.61	.65	.77	.72	.73	.61	.59	.57
Rubber	1.54	1.42	1.33	1.37	1.49	1.60	1.71	1.63	1.80	1.75	1.68

Petroleum	2.14	2.08	1.82	1.68	1.88	1.91	2.07	1.87	1.63	1.43	1.06
Food and beverages	.20	.21	.21	.22	.21	.21	.23	.23	.23	.20	.18
Textiles	.19	.19	.26	.29	.26	.26	.26	.25	.22	.20	.21
All manufacturing	2.95	2.81	2.80	2.84	2.79	2.75	2.74	2.63	2.49	2.35	2.17

	1975	1976	1977	1978	1979	1980	1981	1982
Primary metals	.46	.62	.58	.53	.51	.60	.64	.78
Iron and steel	.51	.55	.56	.53	.56	.72	.70	1.08
Nonferrous metals	.77	.68	.61	.53	.46	.48	.58	.54
Machinery	3.33	3.30	3.17	2.99	2.90	3.27	3.35	4.36
Electrical machinery	7.95	7.62	6.66	6.47	6.74	7.14	7.49	8.48
Aerospace	19.66	20.66	21.68	20.14	16.61	15.73	18.46	22.07
Autos and other transportation equipment	2.77	2.60	2.58	2.65	3.05	4.00	3.61	3.89
Fabricated metals	.47	.46	.43	.38	.30	.47	.51	.50
Instruments	5.32	5.32	5.44	5.94	6.64	6.87	7.60	8.29
Stone, clay, and glass	.86	.86	.81	.78	.78	.88	.95	1.05
Chemicals	3.04	2.90	2.71	2.76	2.73	2.87	3.21	3.81
Paper	.60	.65	.64	.68	.68	.68	.71	.79
Rubber	1.71	1.58	1.24	1.14	1.23	1.39	1.46	1.77
Petroleum	1.06	.93	.94	1.02	.85	.78	.89	1.09
Food and beverages	.19	.20	.22	.22	.22	.24	.24	.27
Textiles	.21	.22	.20	.21	.22	.24	.25	.27
All manufacturing	2.26	2.21	2.13	2.11	2.12	2.31	2.50	2.97

NA—Not available.

TABLE IX.—NEW PRODUCTS AS A PERCENT OF SALES YEARS AHEAD—HISTORICAL EXPECTATIONS

[Percent]

Industry	Spring 1957 for 1960	Spring 1960 for 1963	Spring 1961 for 1964	Spring 1962 for 1965	Spring 1963 for 1966	Spring 1964 for 1967	Spring 1965 for 1968	Spring 1966 for 1969	Spring 1967 for 1970
Iron and steel	5	10	7	5	8	9	10	7	8
Nonferrous metals	5	7	11	9	9	13	11	9	16
Machinery	19	16	23	23	22	20	18	23	25
Electrical machinery	18	18	16	22	22	16	23	24	26
Autos, trucks and parts	10	11	11	10	14	16	11	22	24
Aerospace	37	27	29	34	36	24	33	40	49
Other transportation equipment							19	23	12
Fabricated metal products									
Instruments	14	15	13	18	22	26	20	17	18
Chemicals	16	14	20	16	16	18	15	18	20
Paper	9	8	12	10	8	8	8	7	10
Rubber	5	7	7	6	8	19	14	4	7
Petroleum	2	4	5	6	4	3	4	5	7
Stone, clay and glass	8	9	13	13	12	14	13	17	20
Food and beverages	7	8	12	12	7	10	9	11	12
Textiles	12	9	10	13	14	15	15	13	21
All manufacturing [1]	10	12	14	14	13	15	13	15	17

	Spring 1968 for 1971	Spring 1969 for 1972	Spring 1970 for 1973	Spring 1971 for 1974	Spring 1972 for 1975	Spring 1973 for 1976	Spring 1974 for 1977	Spring 1975 for 1978	Spring 1976 for 1979
Iron and steel	7	7	8	8	10	7	6	6	10
Nonferrous metals	14	11	8	10	10	8	9	10	7
Machinery	22	21	20	24	24	26	27	27	25
Electrical machinery	24	20	20	19	17	20	21	20	15
Autos, trucks and parts	24	17	30	31	40	40	73	40	32
Aerospace	49	51	52	31	41	18	27	18	13
Other transportation equipment	20	10	37	15	4	9	9	15	7
Fabricated metal products			19	15	18	15	17	10	16
Instruments	24	20	35	23	24	22	24	19	21
Chemicals	16	16	17	13	16	14	15	9	24
Paper and pulp	8	12	9	19	14	14	10	7	9

Rubber	9	8	6	12	12	17	14	6	9
Petroleum	8	6	6	7	6	5	3	3	3
Stone, clay and glass	16	15	32	14	11	13	13	11	13
Food and beverages	8	8	13	10	10	9	6	8	12
Textiles	20	18	14	18	15	9	17	24	15
Miscellaneous manufacturing	12	11	15	11	19	5	13	9	12
All manufacturing [1]	17	16	19	16	18	15	18	14	15

	Spring 1977 for 1980	Spring 1978 for 1981	Spring 1979 for 1982	Spring 1980 for 1983	Spring 1981 for 1984	Spring 1982 for 1985	Spring 1983 for 1986
Iron and steel	5	9	8	7	9	10	21
Nonferrous metals	6	10	7	4	5	4	9
Machinery	25	26	20	15	12	25	26
Electrical machinery	16	18	21	17	17	21	22
Autos, trucks and parts	18	11	26	67	15	31	25
Aerospace	17	16	27	11	12	40	34
Other transportation equipment	17	9	9	([2])	([2])	([2])	([2])
Fabricated metal products	9	22	12	17	4	17	19
Instruments	21	24	15	31	25	56	43
Chemicals	19	12	12	10	9	11	40
Paper and pulp	8	10	6	6	6	23	7
Rubber	8	14	16	8	11	16	10
Petroleum	3	3	2	5	3	4	6
Stone, clay and glass	11	10	12	10	8	6	4
Food and beverages	11	17	10	13	17	7	15
Textiles	15	15	14	17	2	11	34
All manufacturing [1]	13	14	13	15	11	15	32

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[1] Includes miscellaneous manufacturing.
[2] Not available.

TABLE X.—PERCENT OF R&D GOING FOR NEW PRODUCTS, NEW PROCESSES, AND IMPROVEMENT OF EXISTING PRODUCTS—HISTORICAL

	1974			1975			1976		
	New products	New processes	Improving products	New products	New processes	Improving products	New products	New processes	Improving products
Iron and steel	36	18	76	15	11	74	19	30	51
Nonferrous metals	21	49	30	24	48	28	17	52	31
Electrical machinery	51	11	38	19	10	71	12	6	82
Machinery	40	7	53	43	11	46	25	13	62
Aerospace	24	9	67	47	8	45	41	7	52
Autos, trucks and parts	32	20	48	21	29	50	20	35	45
Stone, clay and glass	21	23	56	41	26	33	20	29	51
Fabricated metals	24	22	54	24	26	50	19	11	70
Instruments	44	23	33	47	16	37	54	13	33
Chemicals	31	18	51	37	12	51	37	8	55
Paper	30	29	41	10	41	49	25	26	49
Rubber	25	24	51	24	15	61	20	15	65
Petroleum	23	39	38	17	45	38	18	40	42
Textiles	21	27	52	21	22	57	25	17	58
Food and beverages	41	25	34	40	22	38	50	20	30
All manufacturing [1]	36	14	50	33	14	53	29	13	58

	1977			1978			1979		
Iron and steel	24	25	51	22	29	49	2.0	9	71
Nonferrous metals	17	50	33	18	54	28	5	27	68
Electrical machinery	9	6	85	30	34	36	32	30	38
Machinery	33	14	53	42	11	47	40	8	52
Aerospace	30	11	59	39	24	37	43	22	35
Autos, trucks and parts	20	38	42	27	33	40	60	19	21
Stone, clay and glass	29	23	48	24	34	42	37	33	30
Fabricated metals	40	28	32	38	19	43	33	17	50
Instruments	62	13	25	55	15	30	80	11	9
Chemicals	30	20	50	26	16	58	31	23	45
Paper	23	30	47	32	19	49	25	24	51

Rubber	27	18	55	40	19	41	29	22	49
Petroleum	25	25	50	25	25	50	23	47	30
Textiles	19	26	55	18	30	52	12	39	49
Food and beverages	38	33	29	34	20	46	20	20	60
All manufacturing [1]	26	17	57	34	24	42	40	22	37
	1980			1981			1982		
Iron and steel	40	16	44	56	10	34	43	13	44
Nonferrous metals	5	73	22	20	46	34	22	26	52
Electrical machinery	35	29	36	41	12	47	37	20	43
Machinery	24	5	71	47	24	29	35	27	38
Aerospace	51	12	37	41	9	44	47	16	37
Autos, trucks and parts	27	11	62	61	19	20	23	12	47
Stone, clay and glass	32	30	38	17	23	60	29	23	47
Fabricated metals	48	19	33	50	20	30	32	22	46
Instruments	73	8	19	40	51	9	76	11	14
Chemicals	31	19	50	25	31	44	27	21	52
Paper	61	8	31	27	29	44	21	55	23
Rubber	28	29	43	32	17	51	29	21	50
Petroleum	13	55	32	20	71	9	27	57	20
Textiles	6	89	5	5	49	46	37	25	39
Food and beverages	29	28	43	16	22	62	19	21	60
All manufacturing [1]	37	19	44	40	23	37	38	21	41

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[1] Includes industries not shown separately.

Chairman RANGEL. Thank you very much.

Now, James Halpern of Baker & Hostetler here in Washington.

STATEMENT OF JAMES S. HALPERN, TAX PARTNER, BAKER & HOSTETLER, WASHINGTON, DC

Mr. HALPERN. Thank you, Mr. Chairman.

Being on this panel of experts and being the last speaker before lunch, I am reminded of the plight of the Chatauqua speaker who went into a town and told the audience he could speak about anything and asked them what they wanted him to speak about. A fellow in back put his hand up and said: "Speak about 2 minutes and then sit down." [Laughter.]

So with that in mind, I will relate my experience in representing some trade associations who have been approached in numerous cases by professors and other experts who have proposals for research. The associations come to my firm and ask what the tax benefits would be. They ask whether a credit is available to their members for research paid for by the association.

We have looked at the law and said that that would be a nice idea, the Internal Revenue Service might allow it, there are joint venture provisions in the present code, but we do not see any certainty to it. With that in mind and starting with the assumption that the credit is a good thing, we would simply recommend that if it is extended and the provisions are reexamined, Congress perhaps make it clear that the credit is available for a passthrough to association members.

There are certain issues of policy on the profit-making activities of exempt activities that would have to be looked at. We would be willing to cooperate with the committee or its staff in looking at those activities.

Thank you for the opportunity to testify.

[The prepared statement follows:]

STATEMENT OF JAMES S. HALPERN, TAX PARTNER, BAKER & HOSTETLER

INTRODUCTION

Mr name is James S. Halpern. I am a member of the New York and District of Columbia bars. I am a partner in the law firm of Baker & Hostetler. Before joining Baker & Hostetler in October of 1983, I served for three years as Principal Technical Advisor to the Associate Chief Counsel (Technical) of the Internal Revenue Service. Prior to that, I both practiced law and taught as a law professor.

My testimony today is restricted to two issues of interest to the Subcommittee: (1) whether present law rules on the availability of the use of the credit have been effective to accomplish Congressional intent, and (2) whether any statutory or administrative changes should be made in the event the credit is continued.

BACKGROUND

In enacting section 44F of the Internal Revenue Code of 1954, Congress intended to stimulate private sector expenditures for research and experimentation. The House Ways and Means Committee Report on section 44F indicates that over the twelve-year period from 1968 to 1979 research expenditures as a percentage of real gross national product (GNP) declined from 2.01% to approximately 1.58%. The tax credit for qualified research was seen as a way to increase expenditures for research.[1]

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[1] H. Rep. No 97-201, 97th Cong., 1st sess. (1981), p. 111; S. Rep. No. 97-144, 97th Cong., 1st sess. (1981), pp. 76, 77.

My experience is that an increasing amount of interest in research is being focused at the trade association level.[2] Such associations can serve either as an independent impetus for research or as a coordinating body for joint efforts by some or all members. This is particularly true with regard to basic research, which may be of little competitive advantage to any particular member of the industry, but may be of great advantage to the industry as a whole.

RECOMMENDATION

I recommend that the statute be amended to accommodate joint research carried out through trade associations, with the credit benefit of such research passing through to members (and possibly nonmembers) who fund such research.

DISCUSSION

Such a change would make the statute more efficient and is consistent with (1) the legislative history of section 44F and (2) administrative policy in a related area, section 174, which deals with a deduction for research and experimental expenditures.

With regard to the present provisions of section 44F and its legislative history, it is clear that Congress contempleted a certain amount of joint venturing in conducting qualified research.

The House Ways and Means Committee Report on section 44F states: "[I]t is intended that the Treasury will issue regulations, for credit purposes only, which will allow the credit in the case of research joint ventures by taxpayers who otherwise satisfy the [trade or business] test and who are entitled to the research results."[3]

Section 44F(f)(2) states that Treasury regulations shall be issued providing for the pass-through of the credit in the case of estates, trusts, and partnerships. Proposed Treasury regulations (viz., section 1.44F-2(a)(4) and -7(a) (2), (3)) have been issued dealing with these entities. It is interesting to note that proposed regulations section 1.44F-2(a)(4) (ii) contemplates research by a partnership that is carried out not on behalf of the partnership, but on behalf of its members (so long as each member is entitled to the research results and would have been entitled to the credit has the member conducted the research itself). Such research expenditures are treated as paid or incurred directly by the member. Id. Thus, the partnership or joint venture is treated as a true conduit.

In Rev. Rul. 73-324, 1973-2 C.B. 72, a member of a trade association was allowed a deduction under section 174 for payments made to the association to carry out research. The Service issued that ruling even though section 174 does not provide for any pass-through. Because section 174 contains no pass-through provision, the Service may have felt compelled to create one. It is unclear how the Service would rule under the same set of facts contained within Rev. Rul. 73-324 if the trade association member were to request a pass-through for section 44F purposes (section 44F had not been enacted when the ruling was issued). On the one hand, the Service may allow the pass-through to be consistent with section 174 treatment. On the other hand, the Service may not allow the pass-through, arguing that Congress explicitly provided for pass-throughs when it enacted section 44F and it did not include trade associations and their members. Therefore, if Congress is willing to make the credit available for expenditures carried out through trade associations, it ought to make this clear by amending the statute to so provide.

I believe a pass-through of the credit to trade association members is in keeping with the legislative history of section 44F, the statutory and regulatory provisions, and the administration of related provisions under section 174.

Thus, I recommend that section 44F be amended to include language along the following lines:

"The Secretary shall issue regulations that allow the qualified research expenditures of a business league described in section 501(c)(6) to be passed through to its members."

My proposal, if adopted, would encourage the extensive involvement of trade associations in funding research. Undoubtedly, certain proprietary right (e.g., patents) would result from such research. If ownership of such proprietary rights remains at the association level, questions with regard to licensing income and other effects on the association's exempt purpose will arise. Perhaps an efficient policy for encouraging qualified research through the use of trade associations may collide with other policies that currently restrict the activities of tax-exempt entities. An examination should be undertaken of the compatibility of policies for tax-exemption with policies for encouraging research and, if such policies are found incompatible, Congress should address the question of which should prevail as better serving the public interest.

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[2] The term trade association is in this testimony used to refer to a business league or other entity promoting the common business interests of a group and exempt from tax under section 501(c)(6) of the Code.

[3] H. Rep., id., at p. 112.

I would be glad to cooperate with members or staff of this Subcommittee in exploring those areas that need examination and, if necessary, in drafting appropriate statutory language to carry out the objectives sought to be accomplished.

CLOSING

I would like to thank the Subcommittee for the opportunity to testify before it today.

Chairman **Rangel**. Thank you.

The trade association's objectives, could that be met through basic research done by universities if they could be earmarked?

Mr. **Halpern**. Some of it could, but they are looking to attract members' contributions for more than just a deduction for their dues to the trade association, they would like a passthrough of any tax benefits that would occur for the members themselves when they undertook the research.

Chairman **Rangel**. Say that again?

Mr. **Halpern**. They are looking to pass through to the members the kind of tax benefits, such as the credit, which would be enjoyed by the members.

Chairman **Rangel**. The business association members would join in with this research firm and be able to get the tax credit for their membership in the firm that is doing the research and development?

Mr. **Halpern**. In a sense. The one or two cases that I have seen, the association has been approached with a research proposal and asked for funding. The members have been willing to fund it and have asked whether they would be entitled to a credit for putting money through the association jointly to do the research, on the understanding that had they directly and without the association in the way funded the research they would have been entitled to the credit.

Chairman **Rangel**. And the association would then turn the research over to the member firms and companies?

Mr. **Halpern**. Yes.

Chairman **Rangel**. Boy, the imagination of those of you that are out there practicing law. It is very interesting.

Let me thank all of you for your testimony. And again, we hope you stay in close touch with the committee. We certainly will be reaching out for any new ideas that may come up in asking for your advice.

Our record will remain open until September 17, in case those of you who have had the opportunity to listen to industry representatives, or if after reviewing the record, feel that there is some additional information you would want to present to the committee. Even if the record is closed, we would still welcome the opportunity for you to bring your views forward.

Thank you so much.

I had indicated we were going to recess, but staff has advised me that there are two panelists that have a time problem. Let us see who is here. The Electronic Industries, are they here, and the National Food Processors? Let us see. Not yet.

The National Machine Tool Builders?

VOICE. We are here.

Chairman RANGEL. Lear Siegler?

VOICE. Yes.

Chairman RANGEL. And Apple Computer?

VOICE. Yes.

Chairman RANGEL. OK. Suppose we take the entire panel, and we will wait for the others. Maybe by the time we get started they will be here. And so I will ask the Electronic Industries Association, Peter McCloskey, to come forward, and he will be with Richard Irwin, the chairman of the Tax Council. And the National Food Processors are not here yet.

The National Machine Tool Builders Association, the chairman. Lear Siegler is here, and Apple Computer, and also the National Association of Manufacturers and the Motor Vehicle Manufacturers Association.

Now, in order to accommodate our witnesses that have time problems, we will hear first from the National Machine Tool Builders Association, and after that the Apple Computer, Inc., and then we will go in the regular order that had been outlined on the witness list.

Mr. PICKLE [presiding]. The Chair will now recognize Mr. Paul Cooper, chairman of the Acme-Cleveland Corp., representing now the National Machine Tool Builders Association. Mr. Cooper.

STATEMENT OF W. PAUL COOPER, CHAIRMAN, EXECUTIVE COMMITTEE, ACME-CLEVELAND CORP., AND CHAIRMAN, NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION, ACCOMPANIED BY C. KIM McCARTHY, LEGISLATIVBE ANALYST

Mr. COOPER. With me this morning is Kim McCarthy, legislative analyst for the association.

Mr. Chairman, we appreciate this opportunity to discuss the research and development tax credit. As our written submission documents, the relevant economic data clearly point to a depressed machine tool industry. Last year machine tool imports, many of which were technologically advanced and defense sensitive, accounted for a startling 36 percent of domestic consumption measured by value.

The Department of Commerce decision on NMTBA's petition for import quotas filed under the national security clause of the trade laws, a recommendation reportedly favorable to the industry, has been submitted to the White House, where it is currently pending. The petition indicates that the industry is struggling to maintain its competitive and technological edge both at home and abroad.

And, like many other industries, the U.S. machine tool industry has been substantially affected by rapid advances in technology and in manufacturing processes, particularly with regard to computer-assisted design and manufacturing. Thus it is clear that expenditures for research and development are the lifeblood of the machine tool business.

In order to compete effectively in domestic and export markets, the industry must retain the ability to continue and increase its investment in R&D. Making the 25-percent R&D tax credit permanent will add a crucial element now absent from R&D planning, the element of certainty.

Many machine tool companies are literally at the crossroads. Some will be deciding whether to transfer their operations offshore. Others may get out of the business entirely. In this regard, a permanent credit would foster more prudent business planning.

We are familiar with the argument which holds that a permanent extension of the credit is unnecessary because in effect it subsidizes R&D which would be undertaken anyway regardless of whether the credit is available. Certainly we recognize that competitive pressures which the industry faces and the attendant need to invest in R&D will continue whether or not the R&D tax credit is made permanent.

But we view the R&D credit as a useful tool which will aid us in our efforts to maintain a competitive edge. In effect, it provides the cash flow for R&D expenditures which on the margin would otherwise not be made or would be postponed.

A permanent credit significantly enhances the ability of machine tool builders to make necessary R&D investments in a timely fashion during the period in which, competitively speaking, timing is everything. We urge the subcommittee to bear in mind the competitive reality of today's international marketplace. As we noted in our written submission, many of our foreign competitors enjoy the benefits of a wide range of R&D assistance, benefits that permit them to penetrate and capture markets which until very recently were dominated by American manufacturers.

The sooner that certainty can be established, the sooner machine tool builders and others will be able to factor the availability of the credit into both long and short-range planning. Thus, despite the fact that the credit does not expire until next year, we urge the Congress to act on this issue as soon as possible.

We believe that the ultimate resolution of this issue comes down to a question of priority: a modest short-term loss in revenue or a potentially robust long-term gain which will manifest itself in terms of increased employment, enhanced productivity and competitiveness, a reduction in the unprecedented trade deficit, and ultimately an expanded tax base.

For the machine tool industry, a permanent R&D tax credit should not in any way be viewed as a substitute for the trade relief which we have requested under the national security clause. The R&D tax credit by its nature assumes an industry that is at the very least on the way out of its current widespread decline. But it is clear that if the present trend of machine tool imports is not temporarily restricted, the preponderance of U.S. capability for the production of machine tools will very soon be transferred offshore.

Thank you, and I am prepared to respond to any questions.

[The prepared statement and supplemental material follow:]

STATEMENT OF W. PAUL COOPER, CHAIRMAN, EXECUTIVE COMMITTEE, ACME-CLEVELAND CORP., AND CHAIRMAN, NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION

I. INTRODUCTION

Good morning, my name is Paul Cooper. I am Chairman of the Executive Committee of Acme-Cleveland Corporation. The company, headquartered in Cleveland, Ohio, designs and provides systems, equipment and services for improving productivity and quality in manufacturing industries: machine tools, cutting and threading tools, electrical and electronic controls, quality control inspection equipment and systems, foundry equipment and related replacement parts and services.

I am Chairman of the National Machine Tool Builders' Association, on whose behalf I am appearing today. NMTBA is a trade association comprised of more than 300 member companies which account for approximately 85 percent of domestic machine tool production. With me this morning is Kim McCarthy, Legislative Analyst for the Association.

Mr. Chairman, we appreciate this opportunity to discuss the research and development tax credit. Our comments will be directed primarily to the provisions of H.R. 4475, the High Technology Research and Scientific Education Act. As you know, the Senate has already passed its version of the Act (S. 2165). We believe that this legislation sends a strong signal to American industry and educational institutions—a signal which clearly indicates that America's posture of world technological leadership is a compelling national priority. In our view, this is precisely the right signal to be sending and we are pleased to offer our support of this timely and important initiative.

Before proceeding with our comments concerning specific provisions of the bill, I would like to give the Subcommittee a very brief overview of the U.S. machine tool industry and where it is today. Machine tools are power-driven machines, not hand held, that are used to cut, form or shape metal. They are, in short, the fundamental elements of industrial and military production. The industry is currently experiencing unprecedented strains—the relevant economic data in shipments, orders, employment, profits, capital formation and capacity utilization clearly point to a depressed industry. (See Appendix I for an update of the economic status of the machine tool industry.) We believe that these strains cannot safely be assumed to be solely a result of fluctuations in the business cycle. In this regard, the phenomenal influx of imported machine tools has played a significant role in the domestic industry's decline. Last year machine tool imports—many of which were technologically advanced and defense-sensitive—accounted for a startling 36 percent of domestic consumption, measured by value. This import share for 1983 represents an increase of more than 30 percent over 1982 levels. NMTBA has filed a petition under the national security provision of the U.S. trade laws, seeking trade relief in the form of temporary quotas upon imports of metal-cutting and metal-forming machine tools.[1] The Department of Commerce's decision on the petition—a recommendation reportedly favorable to the industry—has been submitted to the White House, where it is currently pending. Over 200 members of Congress—including the Speaker, the Majority and Minority Leaders and Whips, and the Chairman of this Committee—have written the President urging his approval of this important national security petition.

II. R&D INITIATIVES ARE ESSENTIAL IF THE INDUSTRY IS TO RETAIN ITS COMPETITIVE EDGE AND REMAIN A VIABLE FORCE IN WORLD MARKETS

The industry is struggling to maintain its competitive edge, both at home and abroad. And like many other industries, the U.S. machine tool industry has been substantially affected by rapid advances in technology and in manufacturing processes—particularly with regard to computer assisted design and manufacturing. Major structural shifts have begun to occur in certain segments of the industry. New electronic and software-based technologies and products are cutting sharply into the markets for many traditional materials and mechanically oriented products and systems. Thus, it is clear that expenditures for research and development are the lifeblood of the machine tool business—in order to compete effectively in domestic and export markets, the industry must retain the ability to continue and increase its investment in R & D.

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[1] In April 1983, NMTBA, represented by Nathaniel S. Howe, Senior Vice President, Litton Industries, Inc., appeared before this Committee to discuss the state of the U.S. machine tool industry. His testimony included a detailed account of the industry and its petition for trade relief filed under Section 232 of the Trade Expansion Act of 1962. See generally, U.S. Congress, House Ways and Means Committee, Subcommittee on Trade, Statement of Nathaniel S. Howe, Apr. 26, 1983 (98th Cong., 1st sess.).

Figure 1, which shows the industry's aggregate expenditures for R & D as a percent of total sales in the years 1973 through 1983, indicates that the industry held fairly steady in its R & D expenditures during most of that period. In fact 1983 shows a rise of over one full percentage point—a 27% increase in R & D's share of total sales over the previous year. This reflects the industry's commitment to a strong R & D program, despite its perilous condition.

However, in the circumstances now facing the industry—particularly when taking into account last year's precipitous drop in shipments—it is far from clear that this trend will continue. We fear that the result will be a vicious circle in which declines in sales and profits will retard technological advances, causing further declines in sales and profits, with the cycle continuing until the industry has fallen irretrievably behind foreign competitors. The risk that the domestic machine tool industry may thus be eclipsed by its foreign competition—as other once-strong United States industries already have been—has ominous implications for the national security, a concern which has been expressed by a number of the cosponsors of H.R. 4475. Many have recognized the direct and substantial link between this industry's ability to invest in R & D and the maintenance of America's national security.

The threat that imports pose to the domestic industry is especially ominous because the significant competitive advantages that imports enjoy are attributable in large part to direct government subsidization or the effects of governmental coordination of machine tool producers. Recently, for example, MITI and Japan's Small Business Agency announced plans to create four subsidizing and financing systems centered around R & D activity; MITI is planning to finance half the costs incurred by businesses engaged in R&D projects in new ceramics, electro-mechanical products and other high-tech fields.[2]

III. THE HIGH TECHNOLOGY RESEARCH AND SCIENTIFIC EDUCATION ACT

NMTBA strongly supports Title I of the bill which, in addition to improving the 25 percent R&D tax credit, eliminates the current sunset provision under which the credit is due to expire at the end of 1985, thereby making the credit permanent and adding a crucial element now absent from R&D planning—the element of certainty. Many machine tool companies are literally at the crossroads—some will be deciding whether to transfer their operations offshore; others may get out of the business entirely. The certainty of a permanent and substantial R&D tax credit would undoubtedly foster more prudent business planning.

We are familiar with the argument which holds that a permanent extension of the credit is unnecessary because, in effect, it "subsidizes" R&D which would be undertaken anyway—regardless of whether the credit is available. Certainly we recognize that competitive pressures which the industry faces—and the attendant need to invest in R&D—will continue, whether or not the R&D tax credit is made permanent. But we view the R&D credit as a useful tool which will aid us in our efforts to maintain a competitive edge. In effect it provides the cash flow for R&D expenditures, which, on the margin, would otherwise not be made or would be postponed. A permanent credit significantly enhances the ability of machine tool builders to make necessary R&D investments in a timely fashion—during a period in which, competitively speaking, timing is everything.

The R&D tax credit was originally enacted in furtherance of a sound public policy objective—enhancement of U.S. productivity and technological competitiveness. Recent economic history illustrates that the need for accomplishing that objective is more pressing than ever before. In this regard, we urge the Subcommittee to bear in mind the competitive realities of today's international marketplace. As we noted earlier, many of our competitors enjoy the benefits of a wide range of R&D assistance—benefits that permit them to penetrate and capture markets which, until very recently, were dominated by American manufacturers.

The sooner that certainty can be established, the sooner machine tool builders and others will be able to factor the availability of the credit into both long and short-range planning.[3] Thus, despite the fact that the credit does not expire until next year, we urge the Congress to action this issue now—for many companies a delay in action of even one year will have significant consequences.

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[2] Japan Economic Journal, Feb. 14, 1984, at 1. It has been amply documented that direct subsidies to joint industry-government R&D projects are a widely used form of government support in Japan. For an excellent synopsis of R&D subsidies currently available to Japanese machine tool builders, see, "Computer-Aided Manufacturing: the Japanese Challenge," Comments Submitted to the United States International Trade Commission, Investigation No. 332-149, by Cravath, Swain & Moore (attorneys for Cincinnati Milacron), December 14, 1982. Also, for a layman's discussion of Japanese targeting of its machine tool industry and a description of its massive R&D subsidies, see the August 1984 Reader's Digest at page 71.

In addition, we commend Title I's extension of the R&D tax credit to start-up corporations and research joint ventures comprised of corporations from different lines of businesses. Currently, the credit applies only to those corporate joint ventures which are "intra-industry." Title I's extension of the credit would, for example, make it available to machine tool builders involved in joint ventures with manufacturers of computers, robotics and other advanced materials handling systems. Joint ventures of this type will undoubtedly become more frequent as technology progresses—especially in the rapidly growing area of flexible manufacturing systems. Extending the credit in this fashion will benefit the industry and contribute significantly toward the achievement of the bill's primary objective—the enhancement of U.S. technological competitiveness.

We undertand however, that this extension was not intended to include R&D Limited Partnerships—a model for joint venture R&D which promotes off balance-sheet, interest-free venture capital funding. While we recognize that the tax incentives already associated with the RDLP) model influenced this decision, we urge the Congress to re-visit this assessment. Currently, there are a variety of investment incentives (including the RDLP) available to individual investors—these incentives are, in effect, competing against one another for investors' dollars. The RDLP is unique in that it is geared specifically toward the promotion of research and product development—as such, it has the potential to generate revenue, thereby increasing the tax base. Extending the R&D tax credit to include RDLPs would presumably make the RDLP a more attractive vehicle for investors. In other words, if these investment dollars are going to be spent in some form of tax-related investment incentive, why not encourage an investment that is both R&D related and which has the potential for creating new wealth?

Title I also revises the definition of qualified research for R&D credit purposes. We understand that in order to ensure that the credit fulfills the purpose for which it was enacted, the definition has been narrowed so as to eliminate all improvements in which cosmetic changes dominate functional changes. Certainly we appreciate the rationale which underlies this clarification. We assume, however, that functional product improvements derived from R&D which may also result in a cosmetic change would be an allowable expenditure under the revised definition, as long as the functional improvement is predominant. This assumption appears to be consistent with the drafters' intent and should be clarified in report language which accompanies the legislation.

We commend Title I's use of the term "business item" to describe the category of development objectives to which qualifying R&D may be directed for credit purposes. NMTBA believes the use of this term, defined to include "processes" as well as "products," is particularly appropriate in an R&D context, where the improvement of manufacturing methods is influenced as much as "processes" as by the end-products themselves., The inclusion of computer software in this definition is especially relevant to machine tool industry R&D efforts, which are increasingly focused on automation and the evolution of numerically-controlled machinery.

NMTBA also supports Title II of H.R. 4475, geared toward the promotion of university and scientific research. Specifically, the machine tool industry will benefit from Title II's creation of a credit equal to 25 percent of that portion of a corporation's payments to universities and other eligible institutions for basic research which exceeds a fixed, historical maintenance-of-effort floor. We believe this credit will promote greater basic research collaboration between NMTBA member companies and universities. This is especially true in light of the fact that Title II adds to the category of qualified organizations to whom corporate payments for basic research are eligible for the credit an organization that is tax-exempt; organized and operated primarily to promote university scientific research; and expends on a current basic substantially all of its funds through grants and contracts for such basic research. This addition is significant because presumably, it would extend the credit to basic research payments made to organizations such as the Cleveland Advanced Manufacturing Center, which brings together Case Western Reserve University, Cleveland State University and Cuyohoga Community College and local industry to conduct research on advanced manufacturing methods. The recently formed Institute of Advanced Manufacturing Sciences in Cincinnati, Ohio provides another example. The Institute is a non-profit, tax-exempt organization designed as a joint enterprise incorporating industry, local and state government and the University of Cincinnati to foster the identification and adaptation of new technology. Both technology centers are partially funded by grants awarded by the State of Ohio under its Edison Partnerships program.

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[3] Recent contacts with NMTBA members indicate that many of those companies operating in a profit mode have made use of the credit since its enactment in 1981. It should be noted, however, that a substantial portion of our membership—including my own company— is and has been operating at a loss and therefore has not been in a position to claim the credit. These companies have indicated their intention to utilized the credit if and when their operations resume at profitable levels. Other companies—primarily small firms—have indicated that bookkeeping requirements associated with use of the credit can be somewhat burdensome. We know of at least one company which has curtailed its use of the credit due solely to the time and expense of credit-related accounting. The legislative intent underlying H.R. 4475 would be defeated entirely if the cost of complying with accounting requirements exceeded the value of the credit itself. We are hopeful that a less onerous accounting procedure can be devised.

A recent survey of our membership indicates that a majority believes that today's engineering graduates are not adequately prepared for substantive R & D in the machine tool industry. In addition, a recent study conducted by the National Science Foundation revealed that university researchers classified about one-fourth of the items in their 1982 research inventories as obsolete and no longer in research use. Of all academic research equipment listed in the 1982 inventories, only 16 percent was characterized as "state-of-the-art." [4] Title II's enhanced deduction for state-of-the-art scientific equipment donations (including computer software) to qualifying educational institutions will help address these problems. The bill defines "state-of-the-art" as equipment which is not more than 3 years old. We respectfully suggest that a cut-off of 3 years is not necessarily an accurate reflection of how quickly technology actually moves in all industries. In this regard, perhaps the better "measuring stick" is that of accelerated depreciation schedules for the particular item to be donated—in the case of machine tools, five years. Machine tool builders and their customers would thus be encouraged not only to donate scientific equipment to a qualifying educational institution, but also to apply the savings resulting from that deduction toward the purchase of new equipment for their plants. This arrangement would be mutually beneficial to both the taxpayer and the recipient institution and could spur an enormously productive capital investment cycle.

IV. CONCLUSION

Detractors of this legislation are quick to point out that its enactment will unquestionably result in a short-term loss of revenue to the Treasury. We recognize that, in light of burgeoning federal deficits, such a concern is not inconsequential. But just as the U.S. machine tool industry views research and development expenditures as an investment in its future, we are hopeful that the Congress will view the R & D tax credit as an investment in the future of American industry. We believe it comes down to a question of priorities—a modest short-term loss in exchange for a potentially robust long-term gain, which will manifest itself in terms of increased employment, enhanced productivity and competitiveness, a reduction in the unprecedented trade deficit, and ultimately, an expanded tax base. Certainly much is at stake and the nation as a whole has a great deal to gain from prompt passage of this legislation.

It should be emphasized, however, that for the machine tool industry, a permanent R & D tax credit should not in any way be viewed as a substitute for the trade relief which we have requested under Section 232 of the Trade Expansion Act of 1962. The R & D tax credit, by its nature, assumes an industry that is, at the very least, on the way out of its current widespread decline. But it is clear that if their present trend of machine tool imports is not temporarily restricted, the preponderance of U.S. capability for the production of machine tools will very soon be transferred offshore.

Thank you.

APPENDIX I.—MACHINE TOOL INDUSTRY ECONOMIC STATUS UPDATE

Because a number of news stories have reported increased orders for machine tools in recent months, some have interpreted these reports as an indication that the machine tool industry has begun a significant recovery and that its economic woes will soon be over.

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[4] NSF's National Survey of Academic Research Instruments and Instrumentation Needs, April 1984. The survey was designed to yield nationally representative information on the amount, condition and cost of existing scientific research in calendar year 1982 in three selected fields: computer, engineering and the physical sciences.

Unfortunately, this is clearly not the case. While orders have increased moderately from last year's levels, those 1982 levels were so extrordinarily low that even a modest increase looks big on a percentage basis. When expressed in real, inflation-adjusted dollars, however, the industry's economic position today can be shown to be more precarious than it was a year ago.

More importantly, even as the total machine tool market has declined over the past three years, the market share of imported machine tools continues to skyrocket. Hence, even with the current modest increase in machine tool orders, an increasingly large percentage is going to foreign manufacturers.

If anything, the most recently available data support even more strongly the industry's contention that a curb on imports is urgently needed to assure the continued viability of a domestic machine tool industry capable of meeting our national security needs.

When the industry's section 232 petition was filed in March 1983, its net new orders were at their lowest level in over a decade in nominal dollars. Far more important, however, in real, inflation-adjusted dollars, orders had fallen to their lowest levels since the recession of the late 1940's.

It is from this 35 year low point that a small increase has taken place.

Using 1972 constant dollars, the value of net new machine tool orders for the first three quarters of 1983 (latest data) are as follows: $99.5 million; $124.9 million; and $146.6 million, for a total of $371.0 million. Real orders for the same period in 1982 stood at $376.2 million, leaving 1983 $5.2 million behind the 1982 totals. While quarterly order levels have strengthened throughout 1983, the industry is clearly far from substantial recovery.

In contrast to the "improved" quarterly averages of 1983, consider the levels of quarterly average real orders in the past few years:

	Millions
1978	$554.1
1979	623.6
1980	450.8
1981	253.2
1982	120.3
1983 (1st 3 quarters)	123.7

Even at the depth of the previous machine tool order recession in 1975, quarterly average orders were almost $215 million, with the worst quarter during that decline being $163.9 million. In other words, to date, the very best quarter of 1983 was still below the very worst quarter of the industry's previous recession! This can hardly be classified as an industry recovery.

Even worse, since the cash flow of the industry is tied to shipments—not orders—the revenues from even the modest 1983 increases in orders will not reach machine tool companies for some time. In fact, shipments in the latest reported quarter (third quarter 1983) stand at the lowest level in real dollars since the end of World War II.

In contrast to the previous year, shipments for the first three quarters of 1983 declined 57.4 percent. The 1982 level, again in real inflation-adjusted dollars, was $972.4 million. The 1983 level is $414.1 million. Since the builders do not receive their money until the machine is shipped, the actual amount of cash coming into the industry today is at an all time low.

Although the industry has been able to rehire a few employees in 1983, we have hardly been able to make a dent. From April of 1980 to July of 1983, employment in the domestic industry plummeted from 110,200 workers to 64,600. This is an average job loss rate of over 1100 persons per month for 40 months. By October of 1983, the industry had rehired only 1400 of these laid-off workers. While orders have shown signs of improvement throughout 1983, in the course of the three quarters following the industry's employment though we were only able to rehire 3 percent of the work force that had been laid off during the industry's long downturn.

Meanwhile, exports by U.S. machine tool makers have declined at a shocking rate. In 1981 exports were just over $1 billion. In 1982, they dropped to $615 million. In 1983, we estimate the final total will be less than $400 million. Given the dire economic status of the U.S. industry's most important export markets—Canada, Mexico, and Western Europe—there is little reason to believe that U.S. builders can look to overseas markets for help in recovering.

Not surprisingly, during the recent recession even imports of machine tools have declined in actual dollars—from about $1.5 billion in 1981, to $1.25 billion in 1982, to a projected $1.0 billion in 1983. Is this good news? Not at all. For the fact is that this 33 percent decline in imports is quite modest compared to the 66 percent drop in domestic shipments during the same time period. During the recession domestic shipments declined by twice as much as imports.

In fact, for a major factor in the consideration of the section 232 petition—the market share of imports—1983 has been the most disastrous year on record. Machine tool imports have taken a dramatic jump in terms of market share in 1983. For the previous three years, the import market share stood at 23.3 percent, 24.9 percent, and 26.8 percent, respectively. But this past year, the gradual pace of market share gain by imports was interrupted. As a result of the plummeting shipment level by the domestic industry, imports are estimated to have risen to a record 36.2 percent of the market—and, to the best of our knowledge, are still rising.

This dramatic and continuing rise in important market share underscores the fact that the threat of import to the domestic industry's viability has increased, not decreased, over the course of the past year.

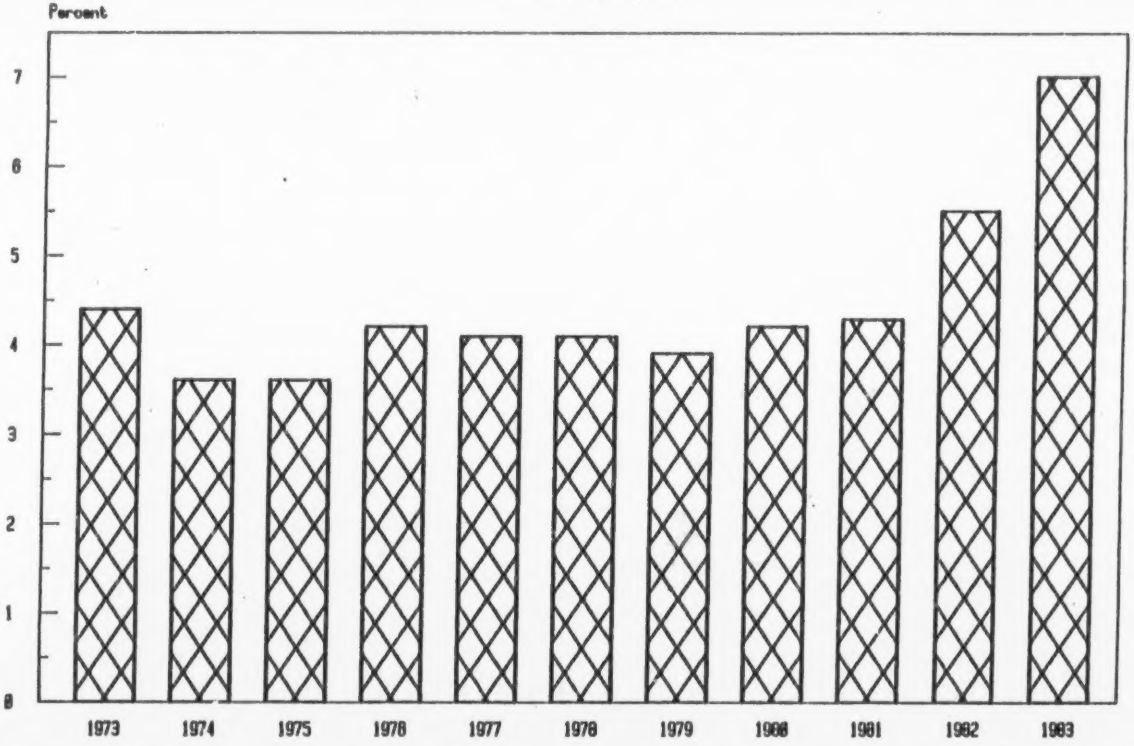
These facts, taken as a whole, lead inevitably to the conclusion that the machine tool industry has remained untouched by the general economic recovery of 1983.

Though nominal dollar orders have made some gains late in the year, in real terms these gains are paltry indeed. Shipments have exhibited no gains; instead plummetting to record lows. Employment in the industry has dropped to the lowest levels experienced in the past thirty-five years. All the while, the flood of imported machine tools has barely slowed. As a result, the hemorrhaging of the nation's domestic machine tool building capacity continues unabated and America's ability to produce the machine tools vital to our defense industries is being further eroded.

Figure 1

Machine Tool Investment in R&D

Percent of Total Sales



Source: NMTBA

National Machine Tool Builders' Association,
McLean, VA, September 17, 1984.

Hon. Charles B. Rangel,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, House of Representatives, Longworth House Office Building, Washington, DC.

Dear Mr. Chairman: This is in follow-up to your recent request concerning the impact and effect of the R&D tax credit. Please find enclosed answers to those questions to which NMTBA is able to respond. NMTBA's membership—representing approximately 90 percent of the domestic machine tool industry—spans all industry sectors which account for numerous and varied product classifications. Thus, answers to certain of the Subcommittee's questions dealing with specific types of research activities and the final product or processes to be affected or created are simply not within a range of data presently available to NMTBA.

In addition, please note that this information is submitted on behalf of W. Paul Cooper, Chairman of the Executive Committee of Acme-Cleveland Corporation and Chairman of NMTBA. Mr. Cooper testified on NMTBA's behalf before the Subcommittee on August 2, 1984. I hope this information will be helpful to the Subcommittee in its evaluation of the R&D tax credit. Should you require any additional material, please let me know.

Sincerely,

C. Kim McCarthy,
Legislative Analyst.

Enclosure.

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

(a) for what year(s), and

(b) in what amount(s)

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

(a) the specific product or experimental activity that would not have been undertaken,

(b) whether such activities would have been deferred to the future or never undertaken, and

(c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

Question 1. As Mr. Cooper's written submission indicates, recent contacts with NMTBA members illustrate that many of those companies operating in a profit mode have made use of the credit since its enactment in 1981. It should be noted, however, that a substantial portion of our membership—including the Acme-Cleveland Corporation—is and has been operating at a low and therefore has not been in a position to claim the credit. These companies have indicated their intention to utilize the credit if and when their operations resume at profitable levels. Other companies—primarily small firms—have indicated that bookkeeping requirements associated with use of the credit can be somewhat burdensome. We know, for example, of at least one company which has curtailed its use of the credit due solely to the time and expense of credit-related accounting. We are hopeful that a less onerous accounting procedure can be devised to that the cost of complying with accounting requirements will not exceed the value of the credit itself.

Question 2. NA.

Question 3. NA.

Question 4. NA.

Question 5. NA.

Question 6. NA.

Question 7. At the present time, many machine tool companies are literally at the crossroads—some will be deciding whether to transfer their operations offshore; others may get out of the business entirely. In this regard, the certainty of a permanent and substantial R&D tax credit would undoubtedly foster more prudent business planning.

We are familiar with the argument which holds that a permanent extension of the credit is unnecessary because, in effect, it "subsidizes" R&D which would be undertaken anyway—regardless of whether the credit is available. Certainly we recognize that competitive pressures which the industry faces—and the attendant need to invest in R&D—will continue, whether or not the R&D tax credit is made permanent. But we view the R&D credit as a useful tool which will aid us in our efforts to maintain a competitive edge. In effect it provides the cash flow for R&D expenditures, which, on the margin, would be postponed. A permanent credit significantly enhances the ability of machine tool builders to make necessary R&D investments in a timely fashion—during a period in which, competitively speaking, timing is everything.

The sooner that certainty can be established, the sooner machine tool builders and others will be able to factor the availability of the credit into both long and short-range planning. That is why, despite the fact that the credit does not expire until next year, we urge the Congress to action this issue now—for many companies a delay in action of even one year will have significant consequences.

Question 8. We understand that in order to ensure that the credit fulfills the purpose for which it was enacted, the definition has been narrowed so as to eliminate all improvements in which cosmetic changes dominate functional changes. Certainly we appreciate the rationale which underlies this clarification. We assume, however, that functional product improvements derived from R&D which may also result in a cosmetic change would be an allowable expenditure under the revised definition, as long as the functional change is predominant. This assumption appears to be consistent with the drafters' intent and should be clarified in report language which accompanies the legislation.

Mr. PICKLE. Mr. Cooper, I understand you are under time constraints. We have several questions to ask and we will examine your entire testimony. I appreciate that you have summarized it.

I would like to know what types of R&D activities we can expect your firms to undertake, with or without tax credits? And I also would like to know what percentage of your firms' R&D expenditures would not have been undertaken except for the R&D credits?

You may not be able to give me that percentage now, but we would like you to respond to us when you can.

Mr. COOPER. Let me briefly describe the procedure that my company uses, and I suspect that which most others use also. We have more projects that we would like to work on than we ever are able to finance. So we plan our R&D budgets at least 5 years in advance.

One reason we have to do that is because building an R&D effort is not solely a matter of building equipment or developing a technology; it is a matter of people, people who have not only technical skills, but more importantly have innovative and creative abilities and finally, must be able to work together, because there are no big developments completed by one person acting alone. It has to be a team effort.

Having outlined each of the projects we would like to work on, with an estimated costs and personnel requirements schedule and a time frame in which it could be done and a total cost for each of these projects, we then try to prioritize those projects which are most promising. And working with a very limited budget as we now have, the tendency is to go for the short-range quick payoff and let some of the perhaps more important long-term technological advances go by the board.

Now, where would the tax credit enter in? If we were building our R&D budget, which we have not done recently—since 1981 we have decreased it each year. So the credit has not been of benefit to my company, for two reasons. One, we didn't have any tax liability because we were hemorrhaging red ink; and two, we were cutting our budget down rather than building it up.

But if we could now start back building it, the 25-percent credit is just that, 25 percent. And we are not going to waste the other money that our company has to put up just to get a 25-percent credit. So it is a help. We would increase our budget, because we look at the after-tax cost of our R&D budget and with the credit, we would have more to work with.

That would mean that this critical element of time might be somewhat condensed or that we might be able to go down our priority ladder a little farther and pick up items that we are now unable to undertake.

Mr. PICKLE. Did I understand you to say that your company in the last 2 years has not availed itself of the R&D credit?

Mr. COOPER. No; we could not.

Mr. PICKLE. Now, do you think you can in the next 2 years?

Mr. COOPER. I do not know. Things are coming back slowly. But we cut down from 7,000 employees to 2,500, just to give you a dimension of the severity.

Mr. PICKLE. This booming economy has not boomed that strongly for you yet?

Mr. COOPER. No; although each month shows a modest increase. If it continues for another 3 years, we might get back.

Mr. PICKLE. Mr. Cooper, we have some additional questions, but I think in the interest of your time we will go to the next witness.

So the next witness would be Michael Rashkin of Apple Computer, Inc.

STATEMENT OF MICHAEL D. RASHKIN, DIRECTOR OF TAXES, APPLE COMPUTER, INC., ACCOMPANIED BY CHARLES M. COOKE, CONSULTANT

Mr. RASHKIN. Apple Computer was incorporated in 1977, but recently we achieved $1 billion of sales in the first 9 months of our 1984 fiscal year. This growth is due largely to our heavy investment in research and development. In fiscal years 1981 through 1983, Apple invested over $100 million in research and development, and in the first 9 months of its fiscal year 1984, Apple has spent over $55 million on research and development.

Apple now employs over 4,500 people. In addition to benefiting from its own research, Apple has benefited from the research of its suppliers, and of companies who independently develop hardware and software products that work with Apple's equipment.

We understand the importance of research, because we have seen firsthand that it can build new industries and create new jobs. We are therefore very interested in section 44(f) credit, which we feel is important in stimulating further research.

In order for the credit to remain effective, it must be properly structured and administered. We are concerned about some of the proposals that have been made, and the way the Treasury has administered the credit. Accordingly, we offer the following recommendations.

First, the activities which qualify for the credit must be clear and unambiguous. The greatest killer of a tax incentive, of the usefulness of a tax incentive is uncertainty. When the Treasury issued regulations stating that software generally did not qualify for the research credit, the Treasury unilaterally destroyed the effectiveness of the research credit for corporations to do software research.

There has been concern as to the type of research activities that should qualify for the credit. The Treasury in their regulations disqualified software, and the Senate recently introduced a targeted definition of research which unfortunately is too complex and ambiguous to be of any value.

A better approach is to start with the section 174 definition, with specific inclusion of software, and to exclude specific activities which Congress may feel should not qualify for the credit.

There is an existing historical background as to the type of activities that qualify under section 174, so that taxpayers have a very good idea of what qualifies and what does not. If Congress finds that rules go too far in certain cases, it is an easy matter to provide specific exception for such activities.

The key thing is that the resulting definition must have a high degree of certainty if it is going to work. More importantly, section 174 covers the type of activity Congress should want to include in a research credit. Section 174 covers research and experimental expenditures which are defined by the regulations to include cost in the experimental or laboratory sense, including costs incident to the development of an experimental or pilot model of a plant, a process, a product, a formula, an invention, or a similar property. These are true research expenditures, and software clearly fits within this definition and should be specifically included in the statute to avoid any confusion.

Our second recommendation is that qualifying costs should include depreciation. Many companies are beginning to increase the amount of research that is done by computers. Computers and other design equipment increase the productivity of engineers and speed up the design process.

By excluding depreciation, section 44(f) is not in accord with current trends in scientific research, and we recommend that depreciation be included in the definition of qualifying research.

Our third recommendation concerns the incremental rule. We think the incremental rule should be eliminated. The incremental rule makes it difficult for management to attribute the research credit to specific projects in specific years. This means at the beginning of a long-term project a taxpayer cannot be sure how the incremental rule may affect the availability of the credit for that project 2 or 3 years down the road.

Moreover, it would be unclear to a manager whether the credit would be earned by the project under consideration or some other project. If the incremental rule were eliminated and the research credit applied to all projects, management could make a more definite determination as to the amount of credit that would be earned on that particular project.

Consequently, the credit would have a more direct impact.

Our fourth recommendation is that the credit should be available for limited partners and limited partnerships. The aim of the credit is to increase research. It does not make sense to discourage individuals from investing in research. With the research credit available to them, many individuals would be willing to take a research-oriented investment risk that otherwise they would not take.

Our fifth recommendation concerns the amount of the credit. The present rate of the credit is necessary, given the restrictions on the kind of expenses that qualify for the credit and the operation of the incremental rule. If any changes are made to expand the definition of qualifying expenses so as to perhaps include depreciation, or if the incremental rule is eliminated, then it would be appropriate to adjust the rate to reflect these changes.

Finally, the credit should be made permanent. Research projects are generally long term in nature, and a research credit simply will not be effective if management is not sure whether the credit will be available halfway through a project.

In sum, we believe the research credit to be an effective tool in promoting an increase in research. We would like your support in continuing it and improving it.

Thank you.

[The prepared statement follows:]

Statement of Michael D. Rashkin, Director of Taxes, Apple Computer, Inc.

SUMMARY

The research and experimentation credit, Section 44F, is effective in stimulating new research and development in creating new industries and jobs. We recommend the following in order to improve the effectiveness of the credit:

(1) The Section 174 definition (with specific inclusion of software development) should be used to determine qualifying research activities.

(2) Depreciation should be included in qualifying costs.

(3) The incremental rule should be eliminated.

(4) Limited partners and partnerships should qualify for the credit.

(5) The present rate is appropriate but should be adjusted if depreciation is included as a qualifying cost or the incremental rule is eliminated.

(6) The credit should be made permanent.

STATEMENT

Apple Computer was incorporated in 1977, and has recently achieved one billion dollars in sales in the first nine months of its 1984 fiscal year. This extraordinary growth is due largely to our heavy investment in research and development. In fiscal years 1981 through 1983 Apple invested over $100 million in research and development. In the first nine months of its fiscal year 1984, Apple has spent $55.6 million on research and development, which represents a 42% increase over 1983. Apple employs over 4,500 people most of them in the United States.

In addition to benefiting from its own research, Apple has benefited from the research of its suppliers and of companies who independently develop products that work with Apple's equipment. Accordingly we understand the importance of research because we have seen first hand that it can build new industries and create new jobs. We are therefore very interested in the section 44F credit, which we feel is important in stimulating further research.

Corporate tax managers like myself are key players in the effectiveness of any corporate tax incentive. we are the people who interpret the tax law for management, and we are the people who help determine a company's earnings benefit from incentive provided by Congress. Accordingly, we are in a very good position to comment upon the effectiveness of a tax incentive and upon how a tax incentive should be structured and administered.

Probably the key to the effectiveness of a tax incentive is how it is structured. If the underlying tax law is unclear or ambiguous, or if the law gives incentives for the wrong kind of activities, the incentive will probably not achieve its intended objectives.

The greatest killer of the usefulness of a tax incentive is uncertainty. For example, when the Treasury issued regulations stating that software generally did not qualify for the research credit, the Treasury unilaterally destroyed the effectiveness of the credit for corporations that do software research.

The uncertainty which usually accompanies tax incentive legislation is produced by the government's ambivalence about granting tax incentives. Generally, there is so much concern over potential abuses that many restrictions and qualifications are added which limit the value of the incentive.

Section 44F is a fairly well structured tax law, but it can stand some improvements. Six areas that must be considered are: 1) the definition of qualifying research activities; 2) the definition of qualifying costs; 3) the amount of research that qualifies; 4) the designation of who qualifies for the credit; 5) the amount of the credit; and 6) the expiration date of the credit.

DEFINITION OF QUALIFYING RESEARCH ACTIVITIES

Secton 44F(d) provides that the term "qualified research" has the same meaning as the term research or experimental has under section 174. Although section 174 does not deal specifically with software, Rev. Proc. 69-21, 1969-2 C.B. 303, provides that the costs of developing software in many respects so closely resembles the kind of research that fall within the purview of section 174 as to warrant accounting treatment similar to that accorded such costs under section 174. Although one may infer from Rev. Proc. 69-21 and from some of the language contained in the ERTA committee reports that Congress intended software research to be included within the meaning of qualified research, Proposed Treasury Regulation 1.174-2(a)(3) states the costs of computer software generally do not qualify as research and experimental expenditures. Moreover the proposed regulation further states that the term does not include the costs for the development of software the operational feasibility of which is not in doubt.

Consequently, it is unclear to taxpayers whether they can obtain a research credit for software development. This confusion must be remedied by amendment to section 44F. We recommend that section 44F should continue to cover research activities as defined by section 174, and software development should be specifically included.

The Senate Finance Committee Report accompanying the Deficit Reduction Act states that the section 174 definition has been applied too broadly in practice and that some taxpayers have claimed virtually all preproduction expenses as eligible for the credit. Moreover, the report states that many taxpayers taking advantage of the credit are in industries that do not involve high technology or its application in developing new or improved products.

The Finance Committee approached this perceived problem by creating a targeted definition of research, which, unfortunately, is extremely complex and ambiguous. Although this definition of research (which was not enacted as part of the Tax Reform Act of 1984) would have probably achieved the Finance Committee's objective of narrowing the credit, it would have made the research credit an ineffective tool, as taxpayers would never be able to tell with any certainty which activities qualified and which activities did not.

A better approach is to start with the section 174 definition (with specific inclusion of software) and to exclude specific activities which Congress may feel should not qualify for the credit.

There is already an historical background as to the type of activities that qualify under section 174 so that taxpayers have a very good idea of what qualifies and what does not. If Congress finds that the rules go too far in certain cases, it is an easy matter to provide specific exception for such activities. The key thing is that the resulting definition must have a high degree of certainty.

More importantly, Section 174 covers the type of activity Congress should want to include in a research credit. Section 174 covers research and experimental expenditures which are defined by the regulations to include costs in the experimental or laboratory sense, including costs incident to the development of an experimental or pilot model, a plant process, a product, a formula, an invention, or similar property. These are true research expenditures.

There has been a great deal of discussion over the development of software, which apparently is a very misunderstood process. As mentioned previously, the proposed Treasury regulations take a very hard position on software, and the report of the Senate Finance Committee on the Deficit Reduction Act implies that there is a range of software activities that do not reach a high enough level of experimentation as to be eligible for the research credit.

However, software is a very important and very complex area of science. This is very well understood by competitors to U.S. industry, who are very aware of the U.S. lead in software and are doing all they can to reduce this lead. The proposals of the Japanese and, more recently, the Canadian governments to reduce legal protection for software is evidence of this. Mr. Tadahiro Sekimoto, President of Nippon Electric Company, has been quoted in the New York Times of January 9, 1983 as saying: "He who controls software controls the world."

Software has become the limiting factor in computerization. While there have been many cost reduction and technological advances in hardware, software has not kept pace. Creating software is not an easy task; it is a high risk and costly adventure. It requires ingenuity and imagination.

With software so critical to our economy, it is unclear why Treasury would specifically exclude software in its regulations. Indeed, software should be singled out, but it should be singled out to be specifically included under section 44F.

QUALIFYING COSTS

Section 44F excludes depreciation from qualifying research expenses. However, many companies are beginning to increase the amount of research that is done by computers. Computers and other design equipment increase the productivity of engineers and speed up the design process. Currently, equipment used in research qualifies as 3-year ACRS property, but this special life for research equipment is not an undeserved exception as it only reflects the reality that research equipment has a very short useful life.

Companies that are on the leading edge of research are using scientific equipment to improve their research. Therefore, by excluding depreciation from qualifying expenses, Section 44F is not in accord with current trends in scientific research. We recommend that depreciation be included in the definition of qualifying expenses.

AMOUNT OF QUALIFYING RESEARCH

Section 44F operates by applying a 25% credit to an incremental amount of qualified research expenses. The theory of the incremental rule is that it rewards those taxpayers who actually increase research expenditures and, consequently, it will motivate taxpayers to increase their research expenditures.

While the theory behind the incremental rule is valid, the incremental rule makes it difficult for management to attribute the research credit to specific projects and specific years. This means that at the beginning of a long-term project a taxpayer could not be sure how the incremental rule may affect the availability of the credit for that project two or three years down the road. Moreover, it would be unclear to a manager whether the credit would be earned by the project under consideration, or some other project.

One approach which makes it easier for management to plan for the credit is to apply the credit across the board to all qualifying expenses and not just incremental expenses. If such rule were adopted, a reduction in the credit percentage would be appropriate.

If the incremental rule were eliminated and the research credit applied to all projects, then a manager could make a more definite determination as to the amount of credit that would be earned on a particular project.

One criticism of this approach is that it appears to reward taxpayers for research activities even if research activities are not increased. However, it seems intuitive that by decreasing the cost of research activities through the credit we are going to dramatically increase the amount or research projects undertaken. Whereas the incremental rule is a Congressional check to make sure that taxpayers do not abuse the incentive, it is a restriction that debilitates the effectiveness of the incentive.

WHO SHOULD QUALIFY FOR THE CREDIT

The credit is generally denied to partners in investment partnerships on the theory that these partnerships would produce tax shelter abuses. Clearly, if the credit is allowed to flow through limited partnerships, there will be those who will abuse it. But on the other hand what better way to increase research in the United States then by letting individual investors receive benefit for the research credit?

If the aim of the credit is to increase research, then it does not make sense to disqualify such a large portion of the investment community. Research is a very risky business. Many efforts result in substantial cost overruns or failure. With the research credit available to them, many individuals would be willing to take the investment risk that otherwise they would not undertake.

We recommend that limited partners be allowed to receive credits on expenditures made by their partnerships.

THE AMOUNT OF THE CREDIT

The present rate of credit is necessary given the restrictions on the kind of expenses that qualify for the credit and the operation of the incremental rule. If any changes are made to expand the definition of qualifying expenses so as to perhaps include depreciation, or if the incremental rule is eliminated, then it would be appropriate to adjust the rate to reflect these changes.

EXPIRATION DATE OF THE CREDIT

Nothing is permanent, and Congress can always repeal any benefit that is enacted. But in order for a research credit to be effective, it should be permanent in the minds of management. Research projects are generally long-term in nature, and a research credit simply will not be effective if management is not sure whether the credit will be available half-way through a project. In the research world delays and cost overruns are a fact of life and uncertainty as to whether a credit will be available detracts from the effectiveness of the credit as an incentive. We recommend the research credit be made permanent.

SUMMARY

The research credit is an effective means of stimulating research, but it can be made more effective with the following changes:

(1) The Section 174 definition (including software) should be used to determine qualifying research activities.

(2) Depreciation should be included in qualifying costs.

(3) The incremental rule should be eliminated.

(4) Limited partners and partnerships should qualify for the credit.

(5) The present rate is appropriate but should be adjusted if depreciation is included as a qualifying cost or the incremental rule is eliminated.

(6) The credit should be made permanent.

Mr. PICKLE. Thank you, sir.

Mr. Rashkin, now, you are on a time limitation also; are you not?

Mr. RASHKIN. That is correct.

Mr. PICKLE. You may respond to this in writing, but the committee would like to know if you have factual information as to the effect of the R&D tax credit program for the past 2 or 3 years. We would like to know whether or not your firm claimed the research tax credit, and if so, what years, and in what amount.

Can you answer that now?

Mr. RASHKIN. I can give you that information.

We have claimed a research credit in 1981, 1982, 1983, and we plan to claim it in 1984.

Mr. PICKLE. All right. You have claimed it 3 years running. In what amount?

Mr. RASHKIN. Our credit for the year 1981—these are rounded numbers—$500,000. For 1982, it was $8 million.

Mr. PICKLE. How much?

Mr. RASHKIN. $8 million. Oh, excuse me; $5 million for 1982, $8 million for 1983. And we forecast $3 million for 1984. I think you can see from the way the incremental rule works it has a strange impact. Our research in 1984 will increase by 42 percent, but our research credit is going down from $8 million to $3 million.

Mr. PICKLE. Now, will you submit for us the type of research that was carried on in the various categories, so we can know how the total relates to a specific category? And we would like to know whether the research is related to basic research, research pertaining to an existing product, or the development of a new product. So, if you would submit that for us.

Mr. RASHKIN. I will submit that in writing.

Mr. PICKLE. Also, we would like to know the type of improvement and product for which the research relates. If you will follow through with a submission to us.

Mr. RASHKIN. I will gladly do that.

Mr. PICKLE. That will be fine. We thank you, sir. And we are sorry we held you up so long, but we could not help it.

Mr. RASHKIN. Thank you very much.

[The following was subsequently received:]

APPLE COMPUTER, INC.,
Cupertino, CA, September 12, 1984.

Mr. JOHN J. SALMON,
Committee on Ways and Means,
Longworth House Office Building,
Washington, DC.

DEAR MR. SALMON: The following is in response to the information requested of me by the Committee in connection with my testimony on August 2, 1984.

Item (1). Whether your firm claimed the research credit. If so, (a) for what years, and (b) in what amounts?

Apple Computer claimed the followed amounts of credits for the fiscal years 1981 to 1984:

1981: $591,636 (4th quarter).
1982: $5,031,302.
1983: $8,318,853.
1984: $2,900,000 (estimate).

Item (2). The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product or development of an new product.

The following response to requests (2) and (3) relates to research done in 1984 but such research is representative of the research done in the other years while the credit has been in effect.

The research activities of Apple are primarily developmental in nature in that they are aimed at the development of new personal computer products (hardware and software), improvement of existing products, and the development and improvement of manufacturing processes related to Apple's products.

Item (3). The final product or process to be affected or created.

In 1984 Apple completed development of a transportable 32-bit personal computer knows as Macintosh. This computer has a unique operating system that is designed to make the computer easy to use. The user can work with the computer simply by manipulating a pointing device known as a mouse. Apple also developed several application software packages to utilize the unique features of the Macintosh. The functions and capabilities of the Macintosh are most fully described in the promotional literature enclosed with this letter. To manufacture the Macintosh, a state-of-the-art automated factory was designed and built in Fremont, California. The development of the Macintosh and Lisa, a related product, has taken over 200 man-years of development effort.

Apple also introduced in 1984 the Apple IIc which is a new version of the Apple II computer. Many other software and peripheral products were also developed, such as Pro Dos (a new operating system), and the Apple Modem.

Item (4). If the credit had not been available, (a) the specific product or experimental activity that not have been undertaken, (b) whether such activity would have been deferred to the future or never undertaken, and (c) the resulting amount of reduction in overall research spending.

The process of deciding how much is to be spent on R&E and on which particular projects is one of discussion, negotiation, analysis, debate, budgeting, and strategy. The R&E credit is a very important part of the process since it allows for a greater budgeting of R&E expenditures without a dollar-for-dollar reduction in earnings or in cash; and greater earnings and cash flow means greater R&E expenditures. But it is impossible to say at Apple what amount of spending and which projects or activities were undertaken soley or primarily because of the credit. There are just too many factors involved in the budgeting process to isolate and quantify the impact of a single factor.

My personal opinion, however, is that the amount of increased research expenditures at Apple as a result of the credit will over the long-term approximate the amount the credit. The reason is that Apple is a technology oriented company and tends to spend as much on research as is permitted by earning and cash flow. The increased earning and cash flow provided by the credit will ultimately be translated into increased research and experimentation activities.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

See item (4).

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

For fiscal year 1984, Apple will report approximately $70 million as research and development costs in its reports to the SEC. For tax credit purposes, there will be approximately $5 million expenses that will be treated as qualified expenses that would not be included in the $70 million reported to the SEC. The difference relates primarily to the different definitions of compensation for SEC purposes and for tax purposes. In prior years as well the primary difference between tax and SEC reporting relates to the differences in the definition of compensation.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

If the credit is made permanent it would become firmly incorporated into the budgeting and planning process of the company, and, as a result, the R&E expenditures of the company would increase on a long-term basis. As mentioned under item (4) Apple will tend to spend as much on R&E as it can afford. If R&E becomes less expensive as a result of a tax credit, more R&E activities will be performed.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

The credit would not stimulate Apple's research activities since Apple does mostly developmental research activities.

Very truly yours,

MICHAEL D. RASHKIN,
Director of Taxes.

Mr. PICKLE. Thank you, sir, very much. You may be excused if you wish now. I understand that Mr. Harry Mussman, executive vice president of the National Food Processors Association, has arrived or is in the room. Is that correct?

Mr. MUSSMAN. Yes, sir.

Mr. PICKLE. You may take a place up here, Mr. Mussman, and you can join the panel.

Before I call on the next witness, I am going to yield to our colleague, the distinguished gentleman from Massachusetts, Congressman Shannon, who has a statement he wishes to submit to us.

STATEMENT OF HON. JAMES M. SHANNON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MASSACHUSETTS

Mr. SHANNON. Thank you, Mr. Chairman. I will try to be very brief.

Let me thank you for your efforts, first of all, Mr. Pickle, on behalf of the R&D credit over the last several years. Your area, like mine, has been an area that has seen real growth in job creation and economic development in the last few years because of some of our newer technological industries, and we all want to see this country adopt policies that will make that continue.

I think it is important to review the reasons why we decided to adopt the research and development credit in 1981, and why so many people feel that it needs to be extended.

To begin with, it is increasingly clear that high tech industries are becoming an ever more essential part of our economy. A study by the Commerce Department issued last year noted that these industries had a rate of growth in output that was twice that of total industrial output, that job creation in high tech in the industries that reported were significantly higher than that of the economy as a whole, and that high-technology products are a key element of U.S. foreign trade, representing about 44 percent of total U.S. manufacturers in 1980.

Yet according to the same study, there has been a decline in the international position of U.S. high technology industries over the past decade. Market share has fallen, and technological advances have shifted overseas. An essential component of these industries almost by definition is large amounts of R&D. According to the American Electronics Association, most high-tech companies devote 12 to 16 percent of their sales revenues to R&D, more than twice the industry average.

And during the 1970's, according to the Commerce Department study, these companies generated more than 60 percent of the private industrial R&D in this country, even though they represented only 13 percent of the value of manufacturing product shipments.

Without R&D, these companies cannot grow, and the U.S. economy cannot grow. Studies have found that as much as 10 percent of the productivity slowdown during the sixties is attributable to the reduced amount of R&D spending during that same period.

When we considered the credit back in 1981, it was obvious that we had not been adequately providing for these factors. Between 1968 and 1979, expenditures for R&D had remained at a stable level in constant dollars. R&D expenditures as a percentage of GNP had stagnated through the seventies. Combined military and civilian R&D had declined from almost 3 percent of GNP in 1968 to 2.3 percent by 1977, and stayed around that level.

Meanwhile, civilian R&D had grown to about 1.9 percent of GNP for Japan, and 2.3 percent for West Germany, both of whom have permanent R&D credits, and both of whom have begun to pose a serious threat to our preeminence in the high tech field. The credit was intended to address this situation, provide benefits for companies increasing their R&D spending, and end the years of stagnation.

And one of the best features of the credit is that it was specifically designed for this purpose. The credit is only for increases in R&D spending. Companies that simply maintain their level of R&D spending and do not try for real innovation will not be able to use it.

And it also provides incentives to do basic research, which has been in a decline over the past few years, and to do it at universities, which have been losing their share of research money. It was not perfectly designed, however. It has some problems. Perhaps the biggest problem is that it was written with a 1985 sunset date.

I cannot emphasize strongly enough my belief that we should eliminate the sunset date and make the credit permanent. If we take no other action on the R&D credit, we must at least do this.

In the period leading up to and during the conference on the Deficit Reduction Act, when we were trying to make the case for accepting the extension of the R&D credit that was in the Senate bill, my staff and I repeatedly heard two arguments: What evidence do we have that the credit is working? And why should we extend it now, when it does not sunset until the end of 1985?

It is true that we do not have as much evidence as we would like as to the effectiveness of the R&D credit. It has, after all, only been in effect for 3 years. What evidence I have seen, however, indicates to me that it has had a positive effect. R&D spending has been on the upswing.

The annual survey of business R&D spending conducted by McGraw-Hill showed healthy increases in such spending in 1981 and subsequent years. It is important to remember that at just this time the country was in the midst of a severe recession. When the usual practice is to cut back spending for both capital assets and research and development, capital spending was indeed cut, but contrary to the usual trend, R&D spending during this period kept on rising.

It is hard to say for sure just how big a role the credit played in all of this, but the impression I have received from listening to executives of high tech companies is that it was a significant factor.

At last year's Senate hearing on the extension of the credit, for example, the treasurer of M/A-Com, Inc., a company in Massachusetts, testified, "The credit has become imbedded in the thinking of our company's senior management, and has had the effect of heightening the corporate priority for research."

Describing a major research project that the company had undertaken, he went on to say, "The presence of this credit made it much easier for us to commit this level of effort, even though it represents an outlay far in excess of any we could expect to recover from the credit for the years to come."

And I might add, Mr. Chairman, that this was a period in this company when earnings were down, but they were willing to make a tremendous commitment of R&D because of the credit.

As to the second argument, a point I have stressed repeatedly is that R&D efforts are not undertaken on the spur of the moment. They require careful planning well in advance. Most high technology companies plan their R&D activity on a 3- to 5-year cycle. This means right from the starting date of the credit its impending sunset was a factor in plans to utilize it.

It also means as we near the expiration date uncertainty over its continuing existence is hampering R&D planning to a greater and greater extent. Thus, we have not really had a true test of the possible effectiveness of the credit, and we cannot have one until it is either made permanent or extended for a period of time that will allow companies to truly utilize it effectively in their planning.

To repeat what I said earlier, if we do nothing else, we must absolutely extend the R&D credit.

I would like to touch briefly on some other problems that have been noted with the credit and how this bill would address them.

One criticism is that the definition of R&D is drawn too broadly so that activities that were not intended to be covered by the credit—I am sure you have heard the stories about the fast food chains and the dress designers—have turned out to be eligible.

The bill makes eligibility more restrictive by excluding R&D that is not related to functional improvements, that is low risk, or that involves postproduction activities, as well as software development that is not truly innovative.

On the other hand, it broadens the credit in an area where it is too narrow by making legitimate startup corporations eligible for the credit.

In addition to these problem-solving provisions, the bill provides a new incentive to companies to perform basic research at universities by allowing them a 25-percent credit for expenditures for basic research exceeding a fixed historical floor.

Finally, it makes depreciation of research equipment eligible for the credit, and as an offset eliminates the special 3-year ACRS life for such equipment, and places it in the 5-year category.

I realize that there has been a lot of concern about the revenue loss associated with these provisions. Without getting into the argument of whether this might be a case where the revenue loss would be a worthy investment, I would like to point out that these provisions are not set in concrete, that it is possible to adjust them so as to greatly reduce the revenue loss, and that the high technology industry has repeatedly expressed its willingness to participate in such an effort.

I think that we ought to give them the chance to do it.

Finally, I know that at a time when we are going over the Internal Revenue Code with a fine tooth comb, any proposal to extend or expand a tax benefit requires some pretty strong justification.

As I have indicated in my testimony, I think that these justifications exist for both the extension of the credit and the improvements contained in H.R. 4475. So, apparently, do a majority of the Members of the Senate, who approved its version of the Deficit Reduction Act containing these provisions, and so do the over 150 House Members of both parties who have cosponsored this legislation.

Compared to the incentives we have granted other industries, most notably ACRS, these provisions are pretty cheap, and it is my firm belief that the return will be great, increased productivity, better trained work force, continuing competitiveness in world markets. If we are going to use the Internal Revenue Code to encourage certain activities, this is the kind of incentive we ought to be providing.

Thank you, Mr. Chairman.

[The prepared statement follows:]

STATEMENT OF HON. JAMES M. SHANNON, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF MASSACHUSETTS

Mr. Chairman and members of the Subcommittee, I appreciate the opportunity to come before you today to talk about the research and development tax credit.

As all of you know, I was the original sponsor of this credit back in 1981, and I am also the sponsor of H.R. 4475, the High Technology Research and Scientific Education Act, which would make some improvements in the credit and make it permanent. So it will come as no surprise to you that I am here to advocate extending the credit, permanently if possible, and adopting the changes contained in H.R. 4475.

I think that it is important to review the reasons why we decided to adopt the R&D credit in 1981 and why so many people feel that it needs to be extended. To begin with, it is increasingly clear that the high technology industries are becoming an ever more essential part of our economy. A Commerce Department study issued last year noted that these industries had a rate of growth in output that was twice that of total industrial output, that job creation in high technology and the industries that support it was significantly higher than that of the economy as a whole, and that high technology products are a key element of U.S. foreign trade, representing about 44% of total U.S. manufactures in 1980. Yet according to the same study, there has been a decline in the international position of U.S. high technology industries over the past decade. Market share has fallen, and technological advances have shifted overseas.

An essential component of these industries, almost by definition, is large amounts of R&D. According to the American Electronics Association, most high tech companies devote 12-16% of thier sales revenues to R&D, more than twice the industry average. During the 1970's, according to the Commerce Department study, these companies generated more than 60% of the private industrial R&D in the U.S., even though they represented only 13% of the value of manufacturing product shipments. Without R&D these companies cannot grow, and the U.S. economy as a whole cannot grow. Studies have found that as much as 10% of the productivity slowdown during the 1960's is attributable to the reduced amount of R&D spending during that same period.

When we considered the R&D credit in 1981, it was obvious that we had not been adequately providing for these factors. Between 1968 and 1979, expenditures for R&D had remained at a stable level in constant dollars, fluctuating between $19 billion and $22.8 billion. R&D expenditures as a percentage of gross national product had stagnated through the 1970's. Combined military and civilian R&D had declined from almost 3% of GNP in 1968 to less than 2.3% by 1977, and had stayed at around that level for subsequent years; civilian R&D had been at 1.5% of GNP since 1968. Meanwhile, civilian R&D had grown to about 1.9% of GNP for Japan and 2.3% for West Germany—both of whom have permanent R&D credits and both of whom have begun to pose a serious threat to our pre-eminence in the high technology field.

The R&D credit was intended to address this situation, provide benefits for companies increasing their R&D spending, and end the years of stagnation. One of the best features of the credit is that it is specifically designed for this purpose. The credit is only for increases in R&D spending; companies that simply maintain their current level of spending and do not try for real innovation will not be able to use it. It also provides incentives to do basic research, which has been in a decline over the past few years, and to do it at universities, which have been losing their share of research money.

The credit was not perfectly designed, however. It has some problems. Perhaps the biggest problem is that it was written with a 1985 sunset date. I cannot emphasize strongly enough my belief that we should eliminate this sunset date and make the credit permanent. If we take no other action on the R&D credit, we must at least do this.

In the period leading up to and during the conference on the Deficit Reduction Act, when we were trying to make the case for accepting the extension of the R&D credit that was in the Senate bill, my staff and I repeatedly heard two arguments: what evidence do we have that the credit is working? And, why should we extend it now, when it doesn't sunset until the end of 1985?

It is true that we do not have as much evidence as we would like as to the effectiveness of the R&D credit. It has, after all, only been in effect for three years. What evidence I have seen, however, indicates to me that it has had a positive effect. R&D spending has been on the upswing. The annual survey of business R&D spending conducted by the McGraw-Hill Company showed healthy increases in such spending in 1981 and subsequent years. It is important to remember that at just this time the country was in the midst of a severe recession, when the usual practice is to cut back spending for both capital assets and R&D. Capital spending was indeed cut—but contrary to the usual trend, R&D spending kept on rising.

It is hard to say for sure just how big a role the R&D credit played in all this. But the impression I have received from listening to executives of high technology companies is that it was a significant factor. At last year's Senate hearing on the extension of the credit, for example, the treasurer of M/A-Com, Inc., a company in Massachusetts, testified that "the credit . . . has become embedded in the thinking of our company's senior management, and has had the effect of heightening the corporate priority for research." Describing a major research project that the company had undertaken, he went on to say, "The presence of this credit made it much easier for us to commit to this level of effort, even though it represents an outlay far in excess of any we could expect to recover from the credit for years to come."

As to the second argument, a point I have stressed repeatedly is that R&D efforts are not undertaken on the spur of the moment. They require careful planning well in advance. Most high technology companies plan their R&D activity on a three-to-five year cycle, This means that right from the starting date of the credit, its impending sunset was a factor in plans to utilize it. It also means that as we near the expiration date, uncertainty over its continuing existence is hampering R&D planning to a greater and greater extent. Thus, we have not really had a true test of the possible effectiveness of the credit, and we cannot have one until it is either made permanent or extended for a period of time that will allow companies to truly utilize it effectively in their planning. To repeat what I said earlier: if we do nothing else, we absolutely must extend the R&D credit.

I'd like to touch briefly on some other problems that have been noted with the credit, and how H.R. 4475 would address then. One criticism if that the definition of R&D is drawn too broadly, so that activities that were not intended to be covered by the credit—I'm sure you've heard the stories about dress designers and fast food chains—have turned out to be eligible. The bill makes eligibility more restrictive by excluding R&D that is not related to functional (as opposed to style or cosmetic) improvements, that is low-risk, or that involved post-production activities, as well as software development that is not truly innovative. On the other hand, it broadens the credit in an area where it is too narrow by making legitimate start-up corporations eligible for the credit.

In addition to these problem-solving provisions, the bill provides a new incentive to companies to perform basic research at universities by allowing them a 25% credit for expenditures for basic research exceeding a fixed, historical floor. Finally, it makes depreciation of research equipment eligible for the R&D credit and as an offset, eliminates the special three year ACRS life for such equipment and places it in the five-year category (the bill also contains provisions relating to the deduction for donations of scientific equipment, but I will limit my remarks to the provisions dealing with the R&D credit).

I realize that there has been a lot of concern about the revenue loss associated with these provisions. Without getting into the argument of whether this might be a case where the revenue loss would be a worthy investment, I would like to point out that these provisions are not set in concrete; that it is possible to adjust them so as to greatly reduce the revenue loss; and that the high technology industry has repeatedly expressed its willingness to participate in such an effort. I think that we ought to give them a chance to do it.

I know that at a time when we are going over the Internal Revenue Code with a fine-toothed comb, any proposal to extend or expand a tax benefit requires some pretty strong justifications. As I have indicated in my testimony, I think that these justifications exist for both the extension of the credit and the improvements contained in H.R. 4475. So, apparently, do a majority of the members of the Senate, who approved its version of the Deficit Reduction Act containing these provisions. And so do the over 150 House members of both parties who have cosponsored H.R. 4475. Compared to the incentives we have granted other industries—most notably ACRS—these provisions are pretty cheap. And it is my firm belief that the return will be great: increased productivity, a better trained workforce, continuing competitiveness in world markets. If we are going to use the Internal Revenue Code to encourage certain activities, this is the kind of incentive we ought to be providing.

Mr. PICKLE. Thank you, Mr. Shannon.

The gentleman from Massachusetts has been a strong leader in recommending R&D credits. I know that you advanced the first credits, and this year you tried very hard to get the R&D credit made permanent in the tax bill. We were not able to do that, and I want the members to know that we were not able to do that because we had a bill before us that was attempting to raise revenue to reduce the deficit, and not to give credits.

There were two different approaches, but we stayed with the fact that we had to get that bill out, and we did. But that does not mean that we now are not trying to find a proper balance or a proper approach for the credits.

I would ask you, Mr. Shannon, just as a matter of comment, knowing that we face enormous deficits, what kind of priority can we give to R&D? Should we change the amount of the credit in view of the deficit? Should we keep the same amount? Should we put our priority into other fields?

How do we as Congress look at it? That is going to be the problem, not whether we want to give credit, or even make it permanent, but really, can we afford it? In view of these deficits, do you have any comment to make about that?

Mr. SHANNON. Well, Mr. Chairman, just a personal comment, if I could.

I think that the ultimate strength of our economy depends upon maintaining our technological edge and our international competitiveness, and trying to increase producivity. The biggest community in my district is the city of Lowell. In 1972, Lowell had the highest unemployment rate in the country of any city over 50,000 people. We did not have any high tech industry in that area at that time, none to speak of.

Since that time, because of proximity to universities, and because of the growth of the high tech industry, Lowell has become a virtual boom town. It has had the lowest unemployment rate in Massachusetts. I think Massachusetts has had the lowest unemployment rate of any of the big industrial States over the last several months. Lowell has had the lowest unemployment rate in Massachusetts for 17 straight months. It is because of the growth of high tech industry.

If we are going to be able to keep our economy strong and keep people at work and bring these deficits down, it is only going to come by keeping that kind of technological edge, and by replicating that experience as much as possible around the country.

And that means that we have got to be willing to make investments where investments are necessary to achieve those results, and R&D is the place, and I mean both direct expenditures for R&D and tax expenditures for R&D are the places, I think, where we have to be willing to make that investment.

Mr. PICKLE. Perhaps you have already stated the answer to the next question I am going to ask you, because you and I know that the proximity of high-tech companies and major research universities is no fluke. It is no accident in either Lowell, MA, or Austin, TX.

Now, with regard to research and development, what type of interaction do you think that business, particularly the high tech firms, should have with the colleges and universities? What role should the Government play in this?

Mr. SHANNON. Well, Mr. Chairman, first of all, I think you know we refer to MIT as the University of Texas of the East. [Laughter.]

I think that the partnership that has existed between particularly high-tech businesses and the universities in my area has been perhaps the most exciting development of this whole recent period of history. Because of that partnership and because of some tax incentives that we worked on together to provide for equipment donations, we have seen students come out of our universities in Massachusetts and I know in Texas and across the country trained on state of the art technology. They have been able to come out and go right into jobs where they can be the most productive workers in those companies from the very first day.

Under the provision that we passed in 1981, Mr. Chairman, which we worked on together to create that special incentive, Wang Laboratories, whose corporate headquarters are located in the city of Lowell, offered and gave high-tech equipment to every State college in Massachusetts and the University of Massachusetts. So every college has had the opportunity to educate their students on the most up-to-date technological equipment.

And I think that that kind of relationship, expanding it so that we have more encouragement for corporations to support faculty positions and more direct research and services and software, is in everybody's best interests. The companies love it because they get more productive workers. The universities find a way to subsidize what are very, very expensive items for them. And the economy is the greatest beneficiary.

And so I think it is very important that we do everything we can to strengthen those ties.

Mr. **Pickle**. My University of Texas has benefited a great deal by the contribution made by the companies in the high tech field to the universities, and I think that is true, obviously, in your universities in Massachusetts, and I am sure it is true of others.

I want to assure you, gentlemen, that we are not going to spend an afternoon brother-in-lawing each other here, although I like what Mr. Shannon says, because Mr. Shannon has introduced a lot of legislation in this field and has been a real leader in it, and I know how deeply he feels about it.

Our problem, Mr. Shannon, though, as you know, is what can we do? What level of credit should we establish? Do we make it permanent? How much? I would particularly be interested in this with Mr. Shannon, because we come from the same kind of area. We will work on it the best we can.

Now, Mr. Shannon, I thank you. We will not carry this on any further. You got your good licks in, so we will excuse you.

Mr. **Shannon**. Thank you, Mr. Chairman.

Mr. **Pickle**. And I thank you for your leadership you have given on this. No one on our committee has been a stronger advocate of R&D in this particular area, and I think it is clear what it has meant to the country. So we thank you.

Mr. **Shannon**. Thank you very much, Mr. Chairman.

Mr. **Pickle**. Now, the Chair will go back to the schedule. Let me ask if the National Association of Manufacturers, Mr. Robert Ragland is here.

All right, Mr. Ragland, we will be pleased to receive your testimony.

STATEMENT OF ROBERT A. RAGLAND, DIRECTOR OF TAXATION, NATIONAL ASSOCIATION OF MANUFACTURERS

Mr. **Ragland**. Thank you, Mr. Chairman. Good afternoon.

I am Robert Ragland, director of taxation for the National Association of Manufacturers. I am pleased to be here this afternoon to present our views on the 25-percent incremental research and development tax credit. As the association has submitted a prepared text for the record of today's hearings, I will take time only to highlight those remarks. There are three points which I would like to make:

First, Federal tax policy should, in our judgment, encourage U.S. companies to invest in research and development. In so doing, Congress promotes our technological advantage in world markets, thereby preserving a high standard of living here through enhanced U.S. competitiveness in world markets.

Second, the research and development tax credit is effective in promoting real research and development, not just definitional changes. Notwithstanding the fact that the economic environment has been highly inconducive to higher research spending, both total and private allocations for R&D have increased in real terms.

Real corporate profits declined by 22 percent peak to trough during the recession of 1981 to 1982, while corporate liquidity deteriorated to its lowest postwar level. Since the level of R&D spending is partially determined by these factors, this situation would ordinarily have been associated with a serious decline in R&D spending. However, this has not been the case. After adjustments, there has been a real increase in R&D outlays of 5.6 percent in 1981 and 5.1 percent in 1982. This is remarkably good by any standard.

Last, the research and development credit is needed to offset the same kinds of R&D tax benefits that our foreign competitors enjoy.

In closing, I would like to spend a moment on the relationship of the R&D credit to Federal deficits. We recognize and share your concern that Federal deficits are threatening economic growth and stability in this country. This concern in recent months led to the enactment of the Deficit Reduction Tax Act, and earlier in the enactment of TEFRA.

Together these revenue measures have raised more than $150 billion in new revenues, and still we have deficits. Already we are talking of another revenue bill in 1985. So far, the bulk of these new revenues have resulted from so-called loophole closures and antiabuse devices. This is shorthand for a broader tax base, and there are those who would urge us to continue on this path by scrapping an entire network of progrowth policies in the name of revenue enhancement. We cannot agree.

Mechanisms like the research and development tax credit are good and deserve your support. They promote productive economic activity and secure a strong position for the U.S. economy both here and abroad. Allowing this and other tax advantaged programs to expire or be repealed is not the way to balance the Federal budget.

Instead, we urge you to make permanent the 25-percent incremental credit for research and development, institute policies of Federal fiscal restraint, and then, to the extent new revenues are needed to support Federal programs, to adopt a transaction-based consumption tax such as the value added tax on goods and services both.

Mr. Chairman, the NAM appreciates——

Mr. PICKLE. Wait a minute. Go over that last part. You slipped that by a little fast.

Mr. RAGLAND. I am sorry.

We would be advocating a value added tax on both goods and services. That saved two lines.

Mr. PICKLE. I just wanted to be sure I did hear you. I am having a hard time hearing those things.

Did you complete your statement?

Mr. RAGLAND. I certainly did.

[The prepared statement and supplemental letter follow:]

STATEMENT OF ROBERT A. RAGLAND, DIRECTOR OF TAXATION, NATIONAL ASSOCIATION OF MANUFACTURERS

I am Robert A. Ragland, Director of Taxation for the National Association of Manufacturers (NAM).

NAM is a voluntary business association of over 13,500 companies, large and small, located in every state. Members range in size from the very large to over 9,000 small manufacturing firms, each with an employee base of less than 500. NAM member companies employ 85 percent of all workers in manufacturing and produce over 80 percent of the nation's manufactured goods. NAM is affiliated with an additional 158,000 businesses through its Associations Council and the National Industrual Council.

On behalf of our members, I am pleased to have this opportunity to present our views on the 25% tax credit for certain incremental research and experimentation expenditures.

I. INTRODUCTION AND SUMMARY

The two major R&D incentives contained in ERTA are the 25% tax credit on incremental R&D expenditures, and a moratorium for two taxable years on the applicability of Section 1.861-8 of the Treasury regulations governing allocation of R&D expenditures between domestic and foreign source income. The moratorium on R&D allocatons under Section 1.861-8 was recently extended for another two years. However, the 25% R&D tax credit is currently scheduled to expire at the end of 1985. NAM supports making this tax credit permanent, on the grounds that this would enhance long-term R&D spending.

The need for preservaton of R&D tax incentives is evidenced by the fact that R&D expenditures in the aggregate underwent a decline during the period 1969-75. The share of Gross National Product (GNP) comprised by R&D is now lower than during its peak levels of the late 1960s. Furthermore, in this respect, the share of GNP comprised by non-military R&D outlays is lower than in most of the other major industrial countries. However, since the enactment of the R&D tax provisions of the Economic Recovery Tax Act of 1981 (ERTA), R&D expenditures have exhibited an upward trend, notwithstanding an unfavorable overall economic environment. The implication is that these ERTA provisions have enhanced R&D outlays, suggesting that such provisions should be retained in order to achieve continued increases in R&D in subsequent years. Moreover, comparable treatment of R&D has long been a feature of the tax provisions of the other industrial countries who compete with us.

II. THE R&D TAX CREDIT: MAJOR PROVISIONS

The incremental credit amounts to 25% of the increase in current qualified R&D expenditures over the base for the particular company. The base is defined as the average of the previous three years' qualified R&D outlays, but not less than 50% of current qualified expenditures. The credit covers all research costs including salaries and facilities except depreciation, while only 65% of research conducted on contract qualifies for the credit. Government financed R&D research conducted outside the United States and certain substantive fields are excluded. Because the creidt would not be usable to corporations sustaining losses, which have no tax liabilities, the credit includes three year carry back and 15 year carry forward provisions.

In NAM's view, the R&D credit as it stands is not perfect, but is nonetheless preferable to the pre-ERTA laws in which no credit was avaliable. Two defects in the current law should be pointed out. First, it qualified R&D expenditures are more than 200% of the base, the base is raided by 50% of the increment over the previously calculated base. This reduces the effective value of the credit by half, with the result that in situations where R&D outlays grow sufficiently rapidly to exceed 200% of the base, the value of the credit falls to 12.5%. A similar problem relates to

R&D conducted during years in which a net loss is sustained. This R&D does not qualify for the credit in the current year, but nonetheless affects the base. Therefore, if the credit is carried back or forward but the revised base exceeds the previous base, the amount of the effective credit is correspondingly reduced.

This defect could be alleviated through repeal of the provision that the current base may not be less than half of current qualified expenditures. NAM urges Congress to consider retaining the credit but with this change, so that increases in R&D exceeding 200% of the base are not penalized.[1]

III. R&D SPENDING IN RETROSPECT

The need to retain tax incentives for R&D outlays is evidenced by the deterioration of R&D spending during the 1970s. Table 1 gives outlays for total R&D in constant 1972 dollars and their annual rate of increase.

During the early 1960s, the United States underwent consistently rapid growth in R&D spending. Real total R&D expenditures increased by 6.3% per year in 1961-66. Starting in the latter part of the decade, however, R&D spending slowed appreciably, to just over 2% per year in 1967-68. This initial slowdown is accounted for in part by slower growth and higher inflation. The economy slowed substantially in 1967 as a result of a tightening of monetary policy the previous year, and although looser money enabled the growth rate to pick up again in 1968, this also accommodated a major acceleration in inflation, which reduced the real value of R&D outlays. A second cause had to do with the Vietnam War. A significant share of R&D is military in nature; however, because of the war escalation, military appropriations were increasingly directed from R&D to supporting the war effort.

The Vietnam War also contributes to an explanation of the decline in R&D in 1969-71, when negative growth rates were in evidence. However, the major cause of the decline appears to have been the recession of 1969-70 which, although relatively mild in historical retrospect, was followed by only a very weak recovery in 1971.

Nevertheless, during the boom of 1972-73, when much more rapid growth rates were achieved, R&D spending failed to improve as rapidly as during previous cyclical upswings in the economy, and in 1973 at the peak of the boom, real R&D spending was still below its 1968 level. A distinctive feature of the 1972-73 recovery in R&D spending was that it was especially weak in the private sector. This appears to trace back to decreased profitability and indirectly to the effect of wage-price controls. During the recovery of the early 1970s, real after-tax profits failed to regain their peak levels of the mid-1960s. In part, this was a result of the 1971-74 wage-price controls program; several studies have documented that the controls worked primarily by depressing prices in relation to unit labor costs, thereby constricting profit margins.

The recession of 1974-75 led to another contraction in R&D spending. In 1975, at the trough of the recession, R&D outlays were 5.3% lower than in 1968.

The recovery of 1976-79 was associated with a major recovery in R&D expenditure, but as measured by the aggregate figures the growth rate of R&D spending did not regain the 6.3% annual rate experienced during the early 1960s, averaging only 4.4% per year in 1976-79. In this respect, while R&D grew more rapidly than overall economic activity during the early 1960s, it grew somewhat more slowly than real GNP in 1976-79. The result is that outlays for R&D accounted for a considerably lower share of GNP than during the previous decade. In 1963-68, R&D spending averaged just under 2.9% of GNP. By comparison, in 1979, R&D spending had fallen to 2.25% of GNP.

Part of the cause of the deterioration of R&D expenditures has had to do with decreases in Federal allocations for research, resulting initially from the escalation of the Vietnam War and subsequently from the gradual shift in the composition of Federal spending from defense-related activities to transfer payments during the 1970s. However, Federal allocations to research do not account for the deterioration in private R&D spending during the early 1970s, which appears to be attributable to cyclical declines in profitability during the recessions of 1969-70 and 1974-75. In this respect, it is significant that industry spending for R&D was stagnant in real terms throughout much of the 1970s. While R&D spending recovered in 1975, because of the earlier decline R&D allocations did not surpass their level of 1969 until 1977. In other words, the decline in R&D spending cannot be attributed to Federal government allocations alone, but also reflects the economic difficulties of the private sector.

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[1] For further discussion of these provisions and possible solutions, see Robert Eisner et al. "The New Incremental Tax Credit for R&D" in National Tax Journal, vol. 37, #2, 1984, pp. 171-184.

One major cause had to do with excessive taxation of corporate income. In this respect, the decline in R&D spending is indirectly traceable to the increase in effective corporate tax liabilities during the 1970's, caused by the overstatement of inventory profits and understatement of depreciation costs. This in itself argues for the retention of tax incentives for R&D, as well as the preservation of ERTA's other business tax provisions, which have facilitated corporate reliquification and a recovery in profitability.

A further argument for retention of the R&D tax credit is that compared with other major industrial countries, the share of GNP devoted to non-military research in the United States has been unfavorably low. Table 2 gives the ratio of total and non-military R&D expenditure to GNP in major industrial countries. Measured in terms of total R&D allocations, the United States has had the highest ratio of R&D to GNP of every major industrial country except the Soviet Union. However, this is due primarily to the higher level of military expenditures in the United States. When military R&D expenditures are factored out, the ratio of civilian R&D to GNP in the United States has averaged below the corresponding ratios for West Germany and Japan, and has been roughly comparable to the ratios for France and the United Kingdom.

IV. THE EFFECTS OF TAX REDUCTIONS

The need to retain the R&D tax credit can also be evidenced through an analysis of the effect of tax credits on the allocation of resources, and the impact of ERTA on corporate profitability.

There is considerable evidence that other business-related tax credits such as the Investment Tax Credit (ITC) have engendered significant improvements in the allocation of funds to the areas they have targeted. Numerous econometric studies have been conducted testing the impact of investment tax provisions in the United States. One recent study by King and Fullerton (1983) uses the TAXSIM model developed by the National Bureau of Economic Research to compare levels of investment with and without the ITC.[2] Investment was found to be raised by statistically significant magnitudes with the ITC in place over the levels that would have prevailed without the ITC. A study using the DRI U.S. macromodel is provided in Sinai and Eckstein (1983).[3] Here also, the ITC is found to have raised investment outlays by a statistically significant percentage. In essence, therefore, tax credits represent an effective means of channelling resources into given types of economic activity. While some studies have questioned the impact of tax credits, these have been subject to considerable criticism on the grounds of misspecification. Based on the econometric evidence on the ITC, there is little ground for assuming that extension of the R&D tax credit will not have a significant impact on research expenditures.

The actual effect of the ERTA R&D tax credit is more difficult to evaluate, due to lack of sufficient data, but preliminary evidence suggests that it has in fact been successful in raising outlays on research relative to what would have prevailed in its absence. Notwithstanding the fact that the economic environment has been highly inconducive to higher research spending, both total and private allocations for R&D have increased in real terms. Real corporate profits declined by −22% peak-to-trough during the recession of 1981–82, while corporate liquidity has deteriorated to its lowest postwar level at this time. Since the level of R&D spending is partially determined by the current profitability and liquidity of the business sector, this situation would ordinarily be associated with a serious decline in R&D spending.

However, as the evidence presented in Table 1 indicates, this has not been the case. Instead, preliminary estimates indicate that R&D spending increased in 1981–82. In constant dollars, total R&D outlays are estimated to have increased 5.2%, over 1980, or by an average of 2.5% per year during this period. While the estimates for total R&D expenditures reveal a cyclical slowdown during the 1981–82 recession, they indicate that the effects of the cyclical decline in economic activity were offset by the ERTA provisions. More recent estimates by Compustat, however, reveal nominal dollar growth in qualified R&D of 14.8% in 1981 and 11.4% in 1982, based on a sample of 592 companies. Adjusted for inflation, this translates into a real increase of 5.6% in 1981 and into 5.1% in 1982, which is well within the range of the National Science Foundation estimates for industrial R&D and remarkably good by any benchmark. Despite the fact that many firms were unable to take advantage of the credit, the credit evidently boosted R&D for the firms that had taxable income. While to some degree increases in qualified R&D outlays in 1981 may have been due to a shift in research activities from ineligible to qualifying categories, this one-time effect has a diminishing impact in future years. Therefore, if the 1982 figures do in fact show increases of the magnitude projected, this should reflect real increases in R&D rather than shifts in outlays from unqualified categories.

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[2] Mervyn King and Don Fullerton, "The Taxation of Income From Capital: Comparative Study of the United States, the United Kingdom, Sweden and West Germany." Chicago, University of Chicago Press, 1983.

[3] Allen Sinai and Otto Eckstein, "Tax Policy and Business Fixed Investment Revisited" in Journal of Economic Behavior and Organization, vol. 4, #1, 1983, pp. 131–162.

Just how good this performance is can be evidenced through a comparison of R&D spending during the 1981-82 recession with the recession of 1974-75, when ERTA's R&D tax incentives were not in place and effective corporate tax liabilities were substantially higher. Although the recessions of 1981-82 and 1974-75 were comparable in terms of length and depth, total R&D spending in 1974-75 fell by −3.1%, which compares unfavorably with the major increases recorded during the recession of 1981-82.

V. R&D TAX PROVISIONS IN OTHER COUNTRIES

Further evidence of the desirability of retaining provisions in our tax laws favorable to R&D is provided by a comparison of the U.S. with other major industrial countries. Prior to ERTA, the tax treatment of R&D in the United States was inferior to that in other industrial countries, where various special R&D tax treatments were allowed in addition to deductibility of R&D expenses. It was only after the enactment of ERTA that the tax treatment of R&D in the United States became comparable to that of our major competitors.

In Canada, current and capital expenditures for research are fully deductible in the year incurred. There is a 7% general investment tax credit for capital expenditures which can also be applied to research-oriented investment spending, and a credit varying between 10% and 25% for research expenditures. There is also a 50% tax credit for incremental research spending in excess of a three year base period amount. Contributions to scientific establishments are also tax deductible.

In West Germany, R&D expenditures are deductible in the year in which they are incurred. Capital expenditures for research facilities are subject to accelerated depreciation, i.e., they are eligible for additional depreciation in the initial write-off period. The acquisitions cost for research conducted by other institutions is depreciable over the useful life of the asset. There is a 7.5% investment tax credit for capital expenditures used in research. Individuals engaged in research are subject to preferential tax treatment, including a 50% reduction on the valuation of income derived from patents and a 50% reduction in qualifying wage income. Qualifying research organizations are exempt from income and net wealth taxes, and contributions to research organizations are tax deductible.

In France, R&D expenditures are deductible in the year in which they are incurred. Capital equipment used for research may be depreciated either through straight-line depreciation (which applies to all other categories of capital assets) or through declining balance methods. Buildings used for research are eligible for faster write-offs. Fifty percent of corporate investments in research organizations are fully deductible. Qualifying income resulting from sales of patents is subject to preferential treatment.

In Switzerland, substantial modifications of normal tax liabilities are allowed for special corporations or subsidiaries handling any number of preferred activities, including research. Preferential rates of depreciation (20% straight line or 40% declining balance) are available for certain kinds of high-technology equipment: EDP, electronic instruments, automation, and new patents.

In Japan there is a 20% R&D tax credit, which is applied incrementally over the previous year's research outlay. The amount of the credit, however, is limited to 10% of a corporation's total tax liabilities.

In essence, up to 1981, tax provisions for R&D in other industrial countries were significantly better than in the United States, giving them considerable competitive advantages in international markets. The R&D tax provisions enacted under ERTA have substantially redressed this inequity by granting American corporations access to the same kinds of R&D tax incentives that their foreign competitors enjoy.

VI. CONCLUSIONS

For these reasons the NAM believes it is important to make permanent ERTA's 25% incremental R&D tax credit, now scheduled to expire in 1985. Further, consideration should be given to the modifications we proposed regarding the base, which would enhance the effect of the R&D credit.

It is apparent that the R&D tax changes enacted in ERTA have contributed to reducing pre-existing biases in our tax laws against research. The ERTA provisions appear to have offset impact of the 1981–82 recession on R&D spending, and raised R&D allocations over the levels they would have attained under the previous tax laws. In the process, they have given American corporations tax advantages comparable to those enjoyed by corporations in other major industrial countries, and in this respect have placed American firms on a more equal competitive footing in world markets.

APPENDIX

TABLE 1.—RESEARCH AND DEVELOPMENT EXPENDITURES IN THE UNITED STATES (1961–82)

Year	Total R&D spending [1]	Rate of change	Percent of GNP
1961	$20.6	5.1	2.73
1962	21.8	5.8	2.73
1963	23.7	8.7	2.87
1964	25.9	9.2	2.96
1965	26.9	3.8	2.89
1966	28.4	5.5	2.88
1967	29.2	2.8	2.89
1968	29.8	2.0	2.82
1969	29.6	.6	2.71
1970	28.5	−3.7	2.63
1971	27.8	−2.4	2.48
1972	28.4	2.1	2.40
1973	29.1	2.4	2.32
1974	28.8	−1.0	2.29
1975	28.2	2.0	2.27
1976	29.5	4.6	2.26
1977	30.7	4.0	2.24
1978	32.0	4.2	2.23
1979	33.7	5.3	2.25
1980	35.1	4.1	2.33
1981	[2] 36.1	[2] 2.8	[2] 2.37
1982	[2] 36.9	[2] 2.2	[2] 2.45

[1] Billions of constant 1972 dollars.
[2] Preliminary estimates.
Source: National Science Foundation.

TABLE 2.—RATIO OF R&D EXPENDITURE TO GNP, SIX COUNTRIES (SELECTED YEARS [1])

Country	1964	1969	1972	1975	1978
(A) Total R&D:					
United States	2.96	2.71	2.40	2.27	2.23
France	1.81	1.94	1.86	1.80	1.76
West Germany	1.57	2.05	2.33	2.38	2.37
Japan	1.48	1.65	1.85	1.94	1.93
United Kingdom	2.29	2.22	2.06	2.05	2.11
U.S.S.R	2.87	3.03	3.58	3.69	3.47
(B) Nonmilitary R&D:					
United States	1.31	1.49	1.44	1.50	1.54
France	1.34	1.52	1.35	1.39	1.35
West Germany	1.38	1.81	2.13	2.19	2.19
United Kingdom	1.49	1.66	1.48	1.39	1.47
Japan	1.47	1.64	1.81	1.89	[2] 1.87

[1] Certain years not available.
[2] Estimated.
Source: National Science Foundation.

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

(a) for what years(s), and

(b) in what amount(s)

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

(a) the specific product or experimental activity that would not have been undertaken,

(b) whether such activities would have been deferred to the future or never undertaken, and

(c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

NATIONAL ASSOCIATION OF MANUFACTURERS,
TAXATION AND FISCAL POLICY DEPARTMENT,
Washington, DC, August 15, 1984.

Hon. CHARLES B. RANGEL,
Chairman, Subcommittee on Oversight, House Ways and Means Office Building, Washington, DC.

DEAR MR. RANGEL: This responds to your request that witnesses before the subcommittee on the captioned subject supply additional data regarding corporate use of the 25 percent incremental tax credit for research and development activities.

Although many of our member companies engage in research and development activities, the NAM as a manufacturing trade association does not. Consequently we are not in a position to respond to the subcommittee's questions.

Sincerely,

ROBERT A. RAGLAND,
Director of Taxation.

Mr. PICKLE. Well, Mr. Ragland, we have a series of questions for the panelists, particularly about how the credits are used, how much, and to what extent. And I assume that would not apply to your organization. I assume you have not used the R&D credit yourself?

Mr. RAGLAND. I just get to talk about them. I do not have to spend the money.

Mr. PICKLE. Well, I do appreciate your advocacy of these credits being made permanent. I do not know that all the committee would share your feelings that these credits would have nothing to do with the deficits. Congress normally does not take into consideration all of the wonderful feedback you get from these credits. Everybody says, we will make money in the long run if you give these credits, it will bring more back to the Treasury.

It sounds good, but I have not seen the proof of that. But it is a factor to be considered.

So we appreciate your testimony very much. We are glad to have it and I am glad to hear the figures you had, that the study shows how effective they have been with the firms that you have canvassed. So that is helpful. So we thank you very much.

Mr. Ragland. Thank you, sir.

Mr. Pickle. Now we will go to the next witness, Mr. John S. Nolan, counsel to the Motor Vehicle Manufacturers Association.

STATEMENT OF JOHN S. NOLAN, COUNSEL, MOTOR VEHICLE MANUFACTURERS ASSOCIATION

Mr. Nolan. Thank you, Mr. Pickle.

I represent the Motor Vehicle Manufacturers Association, MVMA, which is an association of the principal U.S. manufacturers of domestic automobiles, trucks, and buses. Last year the U.S. automotive industry spent $4.4 billion on basic and applied research and development. This was a continuation of the U.S. automotive industry's strong financial commitment to regain its technological leadership and competitive position in the worldwide automotive market.

This $4.4 billion represented 16 percent of all non-Government research and development activities in the United States last year, and two of our members, General Motors and Ford, were among the four largest companies with the largest research and development budgets in the country.

These funds have gone to improve the safety, fuel efficiency, environmental protection capacity, quality and functional capacities of motor vehicles. Extraordinary advances have been achieved in all of these areas, and these are research and development advances that will have lasting benefits throughout all of U.S. industry.

Accordingly, MVMA strongly recommends that the research and experimentation tax credit be made permanent. The credit has had substantial effects in inducing these technological breakthroughs in the development of U.S. automotive products.

We also strongly urge that the definition of "qualified research" in the present statutory provisions be clarified to eliminate uncertainty in its application to applied research and development activities in the automotive industry.

Now, Mr. Chairman, the principal issue before this House is what is the impact of the R&D credit on actual research and development expenditures. Our members in answering the recent GAO survey made a careful effort to determine that impact. We found that the application of the research and development tax credit was indeed taken into account in a very direct way in our budgeting processes of our member companies.

That is to say, the costs of research were viewed as having been substantially reduced by the availability of the credit. More importantly, the Government has thereby undertaken to share in the risk of our research and experimentation by automotive companies. And the incremental feature of the credit, while it could be improved, clearly stimulates higher and higher levels of research and experimentation in our industry to obtain the sharing of the risk.

And indeed, research and experimentation is highly risky in our industry. We are subject to intense competition from Japanese and European manufacturers who enjoy the benefits of government sponsorship of their research. This has led to a wide diversity of products. It has led to the need to adapt many new technological developments into products immediately, with the result that our products are constantly changing.

We are subject to stringent Government regulation with respect to safety, fuel efficiency, environmental consequences. Our research and experimentation is costly and venturesome. We are required to mass produce our products by efficient processes when those products are highly complex and are constantly changing, and they require enormous capital investment and operating costs.

All of this is by way of saying that research and development is vital to our industry in improving its competitive position and continuing to improve that position, and the research and development credit has indeed had a significant impact in inducing higher levels of research in our industry.

I can refer back to the statement of Assistant Secretary Chapoton in February of 1984 when he pointed out quite correctly that the profit motive alone is not sufficient to lead to socially optimal levels of research and experimentation, because it is indeed impossible to capture all of the benefits of your own research and development investments. Therefore, Government financial support is appropriate in this area—a thought that was very much echoed by John Young, who was Chairman of the President's Commission on Industrial Competitiveness, in his testimony before the House Subcommittee on Science and Technology in June of 1984.

It is for these reasons that we very strongly recommend that the R&D tax credit be made permanent, to allow us to continue to enhance our competitiveness in the world market and thus to increase employment in the United States.

Thank you.

[The prepared statement follows:]

STATEMENT OF JOHN S. NOLAN, COUNSEL, ON BEHALF OF THE MOTOR VEHICLE MANUFACTURERS ASSOCIATION

SUMMARY

Motor Vehicle Manufacturers Association (MVMA) strongly recommends that the research and experimentation tax credit be made permanent. It also urges that the definition of the term "qualified research" in the present statutory language be clarified to eliminate questions concerning the eligibility of important applied research and development activities conducted by the automotive industry for the credit.

MVMA believes that the automotive industry's use of the R&E credit during the past three years has been consistent with the Congressional intent underlying enactment of the credit. During this period the automotive industry has undertaken a substantial commitment to research and development activities, stimulated both by the strong foreign competition and the availability of the R&E credit to reduce the risks inherent in such activities. Largely as a result of such commitment, the automotive industry has substantially rebounded from previous economic declines. If such competitive success is to continue, however, additional substantial research and development activity will have to be conducted in the future, and the R&E credit will provide the necessary assistance and incentive for the automotive industry to be able to make an adequate commitment.

The automotive industry is a major manufacturing industry in the United States. It has a significant impact on our domestic economy. Although it is not generally understood by the public, the automotive industry is engaged in massive research and development—over $4 billion annually, which is approximately 16 percent of the total research and development in the United States. Moreover, because of the continually changing technological, social and economic conditions in the automotive industry, as well as both the aggressive competition of foreign rivals and performance standards set by government regulation, the development of new or improved automotive products and manufacturing process is accompanied by substantial risk.

This substantial risk is most evident in the area of applied research and development, where the automotive industry concentrates most of its R&E activities. The $4 billion size of the financial commitment alone makes the risk of technical success enormous. Permanent enactment of the R&E credit will ameliorate some of this risk and attendant uncertainty.

If the automotive industry is to continue to compete effectively with its foreign rivals, it must be able to make the transition of incorporating basic research technology into new products and production processes that are industrially and commercially feasible. Automotive products are highly complex, and the adaptation of new basic technology to commercial reality is a long, costly and uncertain process. The automotive industry is faced with stiff competition in its ability rapidly to translate basic research advances into new and improved competitive products. Consequently, applied research and development activities must not be discouraged through a lack of clarity in the statute setting forth the standards of the R&E credit.

It is submitted that MVMA's recommendations in this regard are administrable and fair. They simply seek a practical definition of the term "qualified research" that will serve the initial intent of Congress to provide a tax credit that encourages the development of private sector technology to compete with foreign businesses for a larger share of the domestic and foreign markets for manufactured goods.

STATEMENT

I am John S. Nolan of Miller & Chevalier, Chartered, Washington, D.C. I appear on behalf of the Motor Vehicle Manufacturers Association of the United States Inc. (hereinafter MVMA), a trade association comprising the principal manufacturers of domestic automobiles, trucks and buses.[1] The tax treatment of research and experimentation expenses is an exceptionally important matter to the automotive industry. Last year alone the automotive industry spent approximately $4.4 billion on research and development activities, representing approximately 16 percent of nongovernment industrial research and development expenditures in the United States during such period. This $4.4 million research and development figure was substantially greater than the research and experimentation expenses which were eligible for the tax credit that is the subject of this hearing, largely because of the incremental limitation on the credit.

MVMA strongly recommends that the research and experimentation tax credit (§ 44F-hereinafter R&E credit) be made permanent. Additionally, the definition of the term "qualified research" in the presnt statutory language[2] should be clarified to eliminate questions about its application to important applied research and development activities in the automotive industry. The substantial commitment of the automotive industry to its research and development activities has been clearly stimulated by the R&E credit. Moreover, the automotive industry believes that its use of the R&E credit has been consistent with Congressional intent, particularly in light of the strong foreign competition which the industry faces.

In addition to the comments which follow, MVMA may have technical comments with respect to other areas of suggested testimony for this hearing. To economize time, however, should comments on the other areas be indicated, they will be provided in a written submission to be filed by August 17, 1984, in accordance with the Subcommittee's announcement (Press Release #18).

IMPACT OF THE R&E CREDIT ON THE AUTOMOTIVE INDUSTRY

During 1983, the automotive industry spent $4.4 billion on all its research and development activities, which can be divided between basic research and applied research. Approximately $400 million was spent on programs for basic research. The balance of $4 billion was spent on industrial or applied research, to produce new and improved products and manufacturing processes. With respect to these amounts, substantially less qualified for the R&E credit dut to the special definition of qualified research and the incremental limitation of the credit.

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[1] The member companies of MVMA are: AM General Corp.; American Motors Corp.; Chrysler Corp.; Ford Motor Co.; General Motors Corp.; International Harvester Co.; M.A.N. Truck and Bus Corp.; PACCAR Inc.; Volkswagen of America, Inc.; Volvo North America Corp. MVMA represents members in matters that affect the interests and welfare of automotive industry.

[2] Particularly section 44F(d).

The automotive industry's enormous research and development commitment has resulted in recent new automotive products on our streets and highways which are substantially different from those of the past in concept, engineering and manufacture. These new products are safer, more fuel efficient, more durable, and of higher quality. They provide many new operating functions.

In basic research, the automotive industry has pioneered new developments in such areas of electroplating plastics, elastomeric filaments, and measurement by use of gamma rays. Technological advances realized in areas such as these will be beneficial to many other industries. In fact, it is little known that some members of the automotive industry have done significant basic research in such areas as acid rain and microelectronics, which potentially have even broader application throughout our society.

The automotive industry's efforts in the applied research area have also been impressive in recent years. For example:

(1) An electric power steering system has been developed for use in cars and trucks. The principal advantages of such a system are improved fuel efficiency and no steering loss if the engine stalls.

(2) The first pure methanol compression-ingnition engine has recently been developed. This engine represents a technical breakthrough because it had not previously been thought practical to use methanol as a fuel in compression-ignition (diesel) engines. The methanol engine has recently been used in a pilot program to power buses in a major urban public transportation sysem.

(3) A newly-developed, high-performance, permanent magnetic alloy will substantially reduce the size and weight of electric motors. Magnets made from the alloy will be used in a newly designed cranking (starting) motor, achieving a nearly 50 percent reduction in size and a 45 percent reduction in weight over previous cranking motors. The miniaturization permitted by the new magnets will provide similar benefits when used in other components and in other industries.

(4) A "factory of the future" is under development. Highly automated and controlled by computers, this project brings together for the first time the latest technology. This facility is a 70,000-square foot learning laboratory designed to increase the rate of implementation of new technology, assess its impact, identify at an early stage any technological gaps that need to be addressed, and develop approaches to long-range technology planning. Initial production by the plant is expected in 1985; full-scale operation is scheduled for 1987.

As is well known, the automotive industry is subject to intense competitive pressures from several sides. These pressures are attributable to, among other things, rapid changes in the technology incorporated in its products, changing customer expectations with respect to automotive products, and aggressive business rivals in foreign countries, many of which have their government's support through research and development tax credits, government sponsored R&E programs, and direct subsidies. Thus, the automotive industry must engage in a continuing, massive research and experimental effort to improve its competitive position in its markets. New technological improvements obtained through R&E activities are essential to enhance automotive product lines and strengthen our domestic automotive industry.

The R&E credit has provided important assistance and incentive to the automotive industry to increase its research and development activities. There are many areas which the industry recognizes as deserving additional research to advance product and process performances beyond the current state of the art. Nevertheless, the annual expenditure that the industry makes for research and development activities is a budgeted item for each company. R&E programs compete with other proposed expenses for inclusion in the budget. In this budget process the R&E credit reduces the risk of undertaking research and development activities and thereby improves opportunities for allocating funds in corporate budgets to R&E. In effect, the "net cost" of R&E is reduced. The companies in the automotive industry take this into account in determining the amount of research and experimentation expenditures that they can afford to budget each year. This "net cost" budgeting concept clearly provides an important stimulus to increase research and development activities.

THE R&E CREDIT SHOULD BE MADE PERMANENT

On February 24, 1984, I testified on behalf of MVMA in support of S. 2165[3] which makes the R&E credit permanent. MVMA urged that the R&E credit should be made permanent, but that certain changes to the statutory language defining the term "qualified research" should be made so that there would be no harmful discrimination against the automotive industry. The principal concern about S. 2165 was that the statutory language failed to ensure that several characteristics of the automotive industry regarding the development of applied technology are given proper effect. This is particularly important, as will be explained later.

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[3] Companion bill H.R. 4475.

In 1983, MVMA also submitted written comments to the Treasury Department concerning the proposed regulation (Reg. § 1.174-2) which defines "qualified research" under the current provisions of the R&E credit. The industry was seriously concerned about the definition in the proposed regulation. This definition substantially departed from the principles set forth in the legislative history of the current law in a manner that severely discriminated against the automotive industry.

Copies of both MVMA's written testimony before the Subcommittee on Taxation and Debt Management of the Senate Finance Committee and MVMA's written comments to the Treasury Department are attached to my written comments submitted today. These prior submissions are incorporated into this MVMA testimony today as relevant to the matters that are addressed here.

The legislative history to the R&E credit discloses that in 1981 Congress intended in the enactment of section 44F of the Code to,

"Overcome the resistance of many businesses to bear the significant costs * * * which must be incurred in initiating or expanding research programs." H.R. Rep. No. 97-201, 97th Cong., 1st Sess. 111 (July 24, 1981) and S. Rep. No. 97-144, 97th Cong., 1st Sess. 76-77 (July 6, 1981).

In the years prior to 1981, U.S. manufacturers had witnessed a significant decline in their innovative and productive capabilities. This development coupled with rising labor costs to keep pace with inflation had seriously undermined the competitive edge that U.S. industries traditionally have had in world markets and at home. There were signs that such developments had the potential to become long-term trends if not reversed by remedial action in both the private and the public sectors. With the developing global economy and intense international competition, this situation was (and still is today) extremely important to the future of our country.

Within this context, the development of new commercially marketable products and new manufacturing processes through industrial applications of recent technological advances is a highly risky activity. In the automotive industry, new and improved products are being developed at an increasing pace, and new technologies are being incorporated into existing products at a rapid rate. Moreover, it is impossible to predict accurately in advance which new technologies and which new applications of technology will be successful. Even successful improvements that are incorporated into products have increasingly shorter commercial life cycles. Moreover, government regulations require substantial, costly testing, and industry companies often must develop new manufacturing processes to incorporate the new ideas in new or improved products before such products can be made and sold on a commercial scale.

At the same time, the automotive industry has also been pressed to maintain "state of the art" products by the incursion of strong foreign competition in world automotive markets.

During recent years, the automotive industry has aggressively sought to reassert its traditional competitive position in the world and domestic markets through increased research and development. In 1983, two automotive companies were ranked among the top five U.S. companies engaged in research and development activities. Indeed, television, newspapers, and other publications have recently published articles about the all-out campaign of the automotive industry to recover from the economic declines of the recent past. Although these efforts, which included important R&E activities qualifying for the tax credit, have produced significant success, sustained success will require continued, increased R&E activities in the future. Foreign competitors will not shrink from the challenge of American industry, but will increase their R&E activities to stiffen competition.

The need for the continuation of R&E activities and the R&E credit's essential role in this regard were specifically recognized last year in the testimony of Assistant Secretary of Treasury Chapoton in support of S. 738, which would have made permanent the R&E credit. The objectives of the R&E credit were described, as follows:

"Congress enacted the tax credit for incremental research and experimental expenditures in order to encourage industry to undertake the risky research and experimental activities that may lead to productivity-enhancing innovation. The need for such activities cannot be disputed; innovation is essential if the United States is to retain and improve its competitive position in the world economy.

* * * * * * *

" 'R&E' is a term used to describe an organized activity undertaken by a firm to develop new products and services or to modify existing products and services. In addition, R&E includes the creation of new or modified production and marketing techniques. Commercial and industrial R&E leading to technological innovation is unquestionably beneficial to the economy. The more successful R&E effort in the economy, the higher will be the rate of productivity growth.

"Normally, it would be expected that business will invest in R&E to the point that the expected return on investment in R&E is equal to the expected returns from other investments. However, the level of profit-motivated R&E frequently will be inadequate because businesses may not enjoy the full return realized from their innovation. For this reason, government intervention * * * is warranted.

"Broad government support of R&E is particularly essential in the area of 'Basic research' * * *.

"Similarly, commercial and industrial R&E also may add to the stock of knowledge that may be used by others, with the result that the innovator will not enjoy the full economic return from its efforts. Therefore, government aid to industrial and commercial R&E also is appropriate."

On February 24, 1984, the Treasury Department restated its continuing strong commitment to the R&E credit in testimony on S. 2165. Assistant Secretary Chapotan testified that commercial and industrial research leading to technological innovation is unquestionably beneficial to the economy.

On June 7, 1984, the Chairman of the President's Commission on Industrial Competitiveness, John A. Young, in testimony before the House Subcommittee on Science and Technology recommended, among other things, further incentives to invest in research and development activities through permanent enactment of the R&E tax credit. He explained that the Commission's recommendations were based on the conclusion that technological innovation is, although essential to maintain U.S. industrial competitiveness, risky and uncertain. In this regard, the Commission's study found that (1) it is difficult to predict which technologies and applications of technology will find acceptance in the market, (2) the market place is constantly changing, (3) technology is both dynamic and mobile (development of new technology is increasing and the life cycle of products is decreasing), (4) the private sector's capacity to fund R&E activity depends on its ability to benefit from such investment, and (5) there are limited federal funds to support R&E activities, so direct federal assistance in conducting or funding R&E should encourage but not displace existing or planned private sector R&E.

The automotive industry also believes that the R&E credit is an appropriate incentive to promote further desirable research and experimental activity. Permanent extension of the R&E credit should further a continued level of R&E activity that will be necessary to maintain a favorable competitive posture in all automotive markets.

THE R&E CREDIT SHOULD BE CLARIFIED TO ENSURE THAT APPLIED RESEARCH AND DEVELOPMENT ACTIVITIES ARE FULLY BENEFITTED

The need to facilitate the transition of technology from basic research through applied research to commercial reality is an urgent one, particularly in the automotive industry where competitive products are being substantially modified and improved on a continuous basis. Other economies in industrialized nations, such as Canada, Japan, the United Kingdom and certain European countries, have had in place for some time mechanisms to encourage and facilitate this all-important process. Several of these countries have combinations of direct subsidies from governmental agencies which provide logistical support to manufacturing industries, and tax credits or similar tax advantages to encourage applied research and development activities in the private sector.

In the automotive industry there are several important examples of recent significant advances in the application of new technologies to industrial production processes and commercial products. For example, during the past several years, there have been important adaptations of (1) robotics for welding and painting product components, (2) computer design to conceive, develop and test new automotive products, and (3) microwave, laser, electron-beam and electro-optic-scanning technologies to enhance quality control functions. All of these developments have had a dramatic effect on the production efficiency of the automotive industry. In like manner, the U.S. automotive industry has achieved substantial adaptation of advances in (1) electronic technology in the areas of automobile instrumentation and controls, and (2) aerospace engineering, materials and features to improve automobile safety, fuel efficiency, quality and durability. These developments have benefitted U.S. consumers in major degree and made U.S. automotive products highly competitive.

It is important to note that automotive products are highly complex, and the adaptation of new basic technology to commercial reality is a long, costly and uncertain process. The automotive industry has made substantial commitments to basic research, and indeed is a leader in developing new ideas and innovations through basic research in the so-called high-tech areas as well as other areas. The automobile industry is faced with stiff competition, however, in its ability rapidly to translate basic research advances into new or improved competitive products.

Industrial and commercial technology is a key determinant of competitive advantage, domestically and internationally. Thus, new applied technology is an important determinant in the automotive industry's economic future. It increases productivity and correspondingly decreases costs per unit produced. It improves the physical quality and durability of products. It makes products and processes safer and more energy efficient.

Applied research and development—the process of converting scientific knowledge into commercial engineering reality—must not be discouraged through a lack of clarity in the statute setting forth the standards on the R&E credit.

COMMENTS OF THE MOTOR VEHICLE MANUFACTURERS ASSOCIATION REGARDING PROPOSED REG. § 1.174-2

The Motor Vehicle Manufacturers Association of the United States, Inc. (MVMA) is a trade association comprising the principal manufacturers of domestic automobiles, trucks, and buses.[1] An important purpose of MVMA is to maintain communications with the government regarding matters that affect the interests and welfare of the motor vehicle manufacturing industry (hereinafter automotive industry). The automotive industry currently accounts for approximately sixteen percent of nongovernment industrial research and development expenditures in the United States.

MVMA submits that the provisions of Proposed Reg. § 1.174-2 are susceptible of unduly restrictive interpretation and, consequently, would have a substantially adverse and discriminatory impact on the automotive industry. These comments explain MVMA's position by: (i) describing the industry and its research and development activities to provide a context for examining Proposed Reg. § 1.174-2; (ii) examining the legal principles and policies underlying section 174; (iii) analyzing the effect of the Proposed Regulation on the automotive industry; and (iv) recommending specific changes in the Proposed Regulation needed to prevent adverse discrimination against the automotive industry.

For the reasons stated below, MVMA requests that Proposed Reg. § 1.174-2 be withdrawn, revised, and reproposed to reflect the recommended changes contained in the attached suggested draft (Exhibit A).

DESCRIPTION OF RESEARCH AND DEVELOPMENT IN THE AUTOMOTIVE INDUSTRY

Importance of research and development to the automotive industry

The past decade has been a period of revolutionary change in the automotive industry. In a short time span, the industry has seen the relatively stable environment in which it previously operated transformed into one marked by rapid and often unpredictable change, including extensive technological change. Research and development has become the critical focal point for the economic recovery of the United States automotive industry.

The domestic automotive industry posted losses of $4.2 billion in 1980 and $1.3 billion in 1981, and realized only a small $322 million profit in 1982.[2] This depressed condition reflects the four-year decline in sales of domestic passenger cars from 9.3 million in 1978 to 5.8 million in 1982.[3] While aggravated by a recessionary economy and high interest rates, an underlying cause of the industry's condition is the significant change that has occurred in the car-buying demands of American consumers.

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[1] The member companies of MVMA are: American Motors Corp.; Chrysler Corp.; Ford Motor Co.; General Motors Corp.; International Harvester Co.; M.A.N. Truck & Bus Corp.; PACCAR Inc; Volkswagen of America, Inc.; Volvo North America Corp.

[2] The profit for 1982 was largely attributable to the one-time sale of capital assets by one manufacturer [Chrysler] and the non automotive operations (e.g., insurance and credit) of another manufacturer [GM].

[3] Passenger car sales were the lowest since 1961, when 5.6 million units were sold.

The standard-sized, all-purpose cars that once accounted for most of the domestic market no longer satisfy the demands of diversified users; such new demands arise from changing economic and social conditions, such as fuel costs, safety concerns, and driving patterns. Instead, the market has become fragmented, with emphasis on so-called specialty cars that satisfy particular transportation needs ranging from basic commuter cars to luxury cars, and including four-wheel drive vehicles, light trucks, sports cars, personal cars, convertibles, recreational vehicles, and the like. There is a major trend among consumers to drive cars longer and, therefore, to demand improvements in product quality, durability, serviceability and repairability. The mean average age of passenger cars in use has increased from 5.5 years in 1970 to 7.2 years in 1982.

A major factor influencing changes in the industry has been the tenfold increase in the price of crude oil. The resulting increase in the price of gasoline induced a corresponding increase in demand for more fuel-efficient vehicles. In the 1960's, American consumers may have considered styling as a principal criterion in purchasing an automobile. By 1980, fuel economy and other technical critiera had become the operative considerations.

Consumer emphasis on fuel economy is demonstrated by increased sales of small cars (compacts, subcompacts and imports), which grew from less than 37 percent of the car sales in the United States in 1970 to nearly 62 percent in 1982. It has been estimated that by 1990, at least 75 percent of the cars sold in this country will be compacts or smaller. Since this trend appears directly affected by fluctuations in gasoline prices, however, recent decreases in gasoline prices create new uncertainties for the future course of development of automotive products.

Intense competition from foreign automotive manufacturers has added impetus to the increased activity in research and development in the industry. The share of the domestic passenger car market held by imports has risen from 15.2 percent in 1970 to 27.8 percent in 1982. Both European and Japanese automotive products are perceived as technologically advanced and feature-intensive. Foreign manufacturers have created an impression of quality construction derived, in part, from the application of the latest manufacturing processes and techniques. These competitors (Japan, West Germany, France and the United Kingdom) are allowed tax credits in their home countries for research and development incurred to develop a new product.

Federal regulations impose significant technical requirements on the automotive industry's production facilities and the motor vehicles that the industry produces. The National Highway Traffic Safety Administration (NHTSA) has promulgated fifty federal safety standards that all motor vehicles sold in the United States are required to meet. NHTSA also administers sixteen additional regulations imposing further requirements, including mileage standards, on motor vehicle manufacturers and dealers.

The Environmental Protection Agency (EPA) has promulgated regulations imposing increasingly stringent limits on permissible levels for vehicle emissions of hydrocarbons, carbon monoxide, oxides of nitrogen and particulates. EPA also imposes strict limits on the permissible discharges and emissions from manufacturing plants. These have important effects on automobile manufacturing. Similarly, the Occupational Safety and Health Administration (OSHA) requires that production facilities conform to numerous safety standards. Additionally, automotive manufacturers must pay a substantial gas guzzler tax (ranging from $350 to $1,550 in 1983) on the sale of each automobile that fails fuel economy standards set at specified levels.

Scope of the automotive industry's commitment to research and development

In 1975, the industry spent approximately $2.0 billion on research and development. By 1980, that figure had increased to $4.2 billion. Research and development expenditures in 1982 are estimated to have been in excess of $4 billion.[4]

This commitment is evidenced by extensive research facilities that employ approximately 30,000 scientists and engineers working in such diverse fields as chemistry, physics, engineering (chemical, electrical, mechanical and materials), metallurgy, ceramics, and computer science. One manufacturer recently began operation of its own wind tunnel, constructed at a cost of $25 million. Several facilities have been established to develop and test robots for use in improving productivity in automotive manufacturing operations. Another new facility is a multi-million dollar paint research center devoted to improving the corrosion resistance, durability, and emissions of the manufacturer's paints and undercoatings. A large commitment of funds—in excess of $100 million—has been invested in computer equipment for the design, engineering, and testing of prospective automotive products.

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[4] National Science Foundation, "Research and Development in Industry, 1980" (January 1981).

The automotive industry is substantially committed to basic research, in which hundreds of millions of dollars are spent annually. During 1981, this expense was approximately $246 million on an industry-wide basis. In addition to basic research, extraordinary expenditures have been made for the reaction of new automotive products and also new production processes, i.e., the task of improving the basic concept of the automobile and the methods of its manufacture. During 1981, the industry incurred approximately $3.99 billion with respect to *applied* research and development.

Significance of the automotive industry's health to the economy

The automotive industry has traditionally played a vital role in the nation's economy. Output of cars and trucks in the United States represented 3.1 percent of the Gross National Product in 1982, down from a recent high of 5.1 percent in 1977. In 1982, automotive manufacturers alone operated 309 production facilities in 35 states, employing 750,000 people at an average total hourly compensation of $19.37.

The United States Bureau of the Census data for 1980, the most recent data available, show that the motor vehicle and equipment industry employed more than 778,000 people and had an annual payroll of $16 billion. An estimated additional 775,000 people were employed in other industries to manufacture automotive parts. The total automotive industry and related businesses (including automotive sales and services, road construction and maintenance, passenger and freight transportation, and petroleum refining and wholesaling) employed nearly 12.1 million people, approximately one-sixth of the private nonagricultural work force.

Nature of research and development activities in the automotive industry

The changing concept of automotive vehicular transportation has brought the industry to the fastest changing, most expensive, and most critical period in its history. In a sense, the industry has evolved into an applied high technology business, using new technologies, materials, and concepts both in the formulation and development of its new products and in the formulation and development of new manufacturing processes. These activities require massive commitments of time, people, and funds.

All this activity must be be conducted in a business environment that requires this industry to mass produce and sell large numbers of complex products to sophisticated consumers with diverse needs. Thus, the industry must develop products that reflect such diverse demands as: (1) customer preferences with respect to performance, economy, roominess, and styling; (2) federal and state regulations concerning safety, emissions, noise, fuel economy, and theft protection; (3) specifications required for export; (4) rapidly-changing concepts in automobile development and design, materials engineering, manufacturing and assembly, and marketing and financing; and (5) world-wide competition that forces severe standards for quality, durability, reliability, serviceability, repairability and image. The foregoing concerns are rarely weighted the same from year to year, although it generally takes six to eight years to bring a new automobile product from the conceptual stage to commercial reality. Presently, the costs are in the billions of dollars for a new automotive product program.

Automotive industry characteristics which influence research and development

Three important facts in the automotive industry substantially influence the industry's research and development. Although evident in other industries in varying degrees, they are particularly prominent in the automotive industry. They make simplified assumptions about automotive products and the manufacture of such products inappropriate. Thus, it is a fact that: (1) both the automotive product and the processes for developing and manufacturing it are much more technically complex than is generally understood; (2) the technology of the automotive product is continually being redefined and improved through the introduction of new models, as well as improved existing models; and (3) many of the functions and features that go into the creation of a new automotive product serve several purposes that may not be evident to the layman.

Complex Products and Production Processes.—The typical automobile has between 5,000 and 6,000 major components, and as many as 12,000 to 15,000 total parts. When these items are brought together to function as one, they create a product of extreme technological complexity. It takes enormous research and development to create such a product when there is a complementary relationship between each major component. Within this context, both automobiles and trucks are offered in a variety of models, including general-use vehicles and specialty vehicles; e.g., commuter cars, high performance cars, luxury cars, vans, minibuses, etc. As a result, the major portion (approximately 90 percent) of the research and development conducted by the industry focuses on improvement of the product concept.

Similarly, the manufacturing processes involved in producing a commercially marketable automotive product are quite complicated. As new materials are developed for use in automotive products, new processes must be developed for producing and installing parts made of such new materials. New manufacturing techniques and processes applied to existing manufacturing must ber adapted and refined for application on a full-scale commercial production line. In addition, the traditional assembly process for any automobile requires intricate timing, logistics, people, technology, quality control at every stage, process and cost considerations, and finished product quality.

Several implications derive from this complexity of product and process in the automotive industry. First, there is a "ripple effect" from any change because of the interplay between product and production process, among parts in the product and among procedures in the production process. Stated differently, this means that when a component of an automotive product is changed, this may result in a variety of changes radiating to other parts, which in turn influence the production processes involved in one or more parts of the vehicle, which when altered to compensate for the product adjustments, may in turn affect some other component part or process.

For example, durability considerations may result in a change in the bumper configuration on an automobile, causing compensating adjustments in the proposed installation process. The new process may only work by decreasing the height of the bumper, however, which makes the bumper fail government safety requirements, which when rectified will require yet another change to the installation process. The reverberating effect of product changes such as this are common during the development stage of a new or improved product. Indeed, this example is simplified, since changes to the bumper and its installation process would affect several other components of the vehicle and the attendant installation processes.

This pervasive problem compounds each step of the design, engineering, and testing of the automotive product and the production process. Furthermore, it is not feasible for a major automotive manufacturer to contract out much of its applied research and development. The result is that a manufacturer's research and development programs consume large amounts of the manufacturer's own activities. Attendantly, the manufacturer's staff must seek to accomplish the indicated design, engineering, testing and evaluation steps in a relatively short time frame for a new automotive product that can be mass-produced and sold. This largely accounts for the normal pattern of conducting significant research and development on various aspects of the particular product and production process until virtually the date that commercial production is commenced on a full-scale plant assembly line.

Continuous Research and Development Activity.—The research and development conducted in the automotive industry is continuous with respect to all aspects of automotive products and their production processes. Although this has been a traditional characteristic of the automotive industry, it has been emphasized in the last decade because of the increase in government regulations, the advent of many new technologies, foreign and domestic competition, and the increase in sophistication of consumers. New developments in automotive transportation now occur so rapidly that it is easy to assume that each bears little significance to the overall product. Although a change may seem "routine" or "incidental" to a layman, the change will of necessity have been dictated by important technological objectives. A technically-unimportant change would be so time-consuming and costly that it would not be made. Indeed, both individual and combinations of improvements which are regularly incorporated into new and existing models have the effect of significantly changing the product concept from a technological standpoint.

Function Dictates Appearance.—It is evident that aside from functional performance, market pressures inject appearance ("style") considerations into the development and production of new automotive products. During some of the history of the automotive industry (1940's through 1960's), the industry was perceived as annually introducing new product lines which were little more than revamped versions of the previous year's lines. The perception was that function followed appearance. Whether justified in prior years, this clearly is no longer the case, for function now dictates appearance. Appearance has, of necessity, become a subordinate consideration. As evidence of this, large and inefficient automobiles with structural compartments of dead space situated to create a particular exterior look are virtually extinct.

Even the changes which were traditionally considered to be purely cosmetic are no longer so. For example, while the fabric used in the interior upholstering of an automobile certainly must satisfy minimum standards of appearance and general attractiveness, choices of fabrics can only be made once the material involved passes numerous tests [5] for safety and durability. Similarly, the general exterior shape and appearance of an automobile, while somewhat influenced by attractiveness, must first satisfy preliminary functional objectives such as crash safety, weight, and aerodynamic design for fuel efficiency, repairability, durability, and passenger vision. Thus, appearance is expressed only to the extent that it is compatible with these other major functional criteria.

These aspects are, and have been in the past, mainly overlooked by the general public, which generally perceives the automobile as a simple product. This is probably due primarily to the fact that many families have more than one automobile, and because automotive transportation is a necessity that is regularly used in every phase of life. People have become so accustomed to operating such complicated equipment that they are unaware of their own technical skills, as essentially pilots, and they do not think about the sophisticated functions that their automobiles routinely perform for them. Such familiarity inevitably leads to the notion that the development and production of automotive products is a routine and simple process.

These perceptions are incorrect, however, for as a product, the automobile, including trucks and buses, is technically comparable to the airplane and computer, which generally are perceived as highly sophisticated products. All three products have numerous parts, which must be assembled by complicated processes to perform numerous sophisticated functions with a high degree of reliability. It is significant that the electronic equipment in the average new automotive product has the capacity to perform more functions than the sophisticated home computers that are now on the market. Moreover, economic pressure to produce annually millions of automobiles and trucks requires production timing and efficiency considerations that, although evident with respect to the manufacture and production of airplanes and computers, are not on the same scale by a large margin. In short, it would be a mistake to categorize the automotive industry as less than highly technology-oriented, involved in substantial research and development, simply because its products are mass produced and used by virtually everyone.

Major areas of research and development in the automotive industry

Product-Related Research and Development.—During the last ten years, research and development has made the automobile a feature-intensive product. It performs numerous functions that were not available only a few years ago. Moreover, even functions previously available have been refined and expanded, raising them to much greater levels of efficiency and performance. For example, substantial improvements have been made in the following areas:

1. *Safety* [6].—Always a major concern of automotive manufacturers, automobiles and trucks are far safer than in previous years due to continuous innovations in the strength and durability of materials in the vehicle, better design, more efficient passenger restraints, better tires, and other improvments.

2. *Emissions.*—Pursuant to government regulations, the automotive industry has reduced the amount of controlled substances in automotive exhausts since 1960 by between 75 and 95 percent. This has resulted primarily from advances in the development of cleaner burning engine and catalytic filter devices in automotive exhaust systems.

3. *Durability, Quality, Repairability and Serviceability.*—Automobiles and trucks are better built to last longer, and they are designed in a manner that facilitates services and repair work. Routine maintenance for new automobiles is now done at

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[5] There are at least 37 applicable engineering specifications (e.g., construction, weight, thickness, texture, breaking strength, tear strength, seam-bond strength, set, stiffness, flex-fold, abrasion-taber, abrasion-stoll, shagging, pilling, minking, loose flock, composition, crocking, bleeding, perspiration, spotting, soiling, fading, cleanability, acoustics, UV degradation, sag, shrinkage, odor, installability-workability, deterioration from heat-cold-humidity, wet-flex, cold-flex, compatibility with other interior materials, allergic or other contaminants, ultra-violet deterioration, heat-cold-electric conduction) as well as safety (flammability and slipperiness-crash characteristics), cost, availability and appearance. All of these go into the development and testing of textile materials used in automobile interiors.

[6] Some of the many tests required to satisfy government safety standards involve such areas as steering characteristics, transmission performance, interior design-headrest and body restraint devices, auto-body crush resistence, accelerator control, fuel system integrity-engine, gas lines and gas tank, bumper performance, glazing, fire resistance of materials, rear vision characteristics, warning devices, instrumentation sufficiency and viewability, braking characteristics and the integrity of the banking system, adequacy of exterior lights and reflective devices, hood latch system performance, tire performance, windshield system performance-defogging, defrosting, wiping and washing, and power window operation.

intervals of 7,500 and 30,000 miles, rather than 3,000 and 10,000 miles as in earlier years. Some moving parts are now self-lubricating for their entire functional life.

4. *Fuel Efficiency*[7].—Due to consumer requirements and government regulations (so-called CAFE requirements (Corporate Average Fuel Economy)), this has been a major focus of research and development in the automotive industry. Automotive manufacturers have spent billions of dollars developing new engine designs and types (e.g., small diesel, rotary, gas turbine and electric), as well as seeking to use alternative materials (e.g., aluminum, plastics, graphite and ceramics) to lighten and strengthen vehicles. Substantial improvements in aerodynamic design have also reduced the co-efficient of drag which increases fuel efficiency. More effective synthetic lubricants, as well as alternate fuels, are being developed to help solve potential fuel shortage problems in the future.

5. *Theft Prevention.*—Sophisticated electronic devices now provide automobiles with security systems similar to those in homes and office buildings. Many models now have indestructible serial numbers on major components. Keyless electronic locks and ignitions are recent innovations.

6. *New Functions.*—New functions in automobiles such as communication (e.g., radio telephone) and sophisticated capabilities for early identification of mechanical or electrical problems are also being advanced toward commercial production.

Incorporating the new concepts and technologies developed in these areas into the automotive product is not simply a matter of "hooking it up." Most of the technology must be adapted and refined for such purpose. This work requires a lead time of two to three years before the new item appears in an automotive product. As a result of this and the risk of compounding errors in a mass production context, the idea of a simple, insignificant improvement to an automotive product is unrealistic.

Process-Related Research and Development.—Revolutionary changes have occurred in the development and production of automotive products. Some areas of substantial improvement are as follows:

1. *Computer Design.*—Computer science now enables new automotive products to be conceived, designed, and even tested to some extent, on computers before such products progress to draft design, mockup, engineering and subsequent development stages.

2. *Robotics.*—Component assembly, welding and painting are several areas in which mass production is being converted to robot operation.

3. *Quality Control.*—Substantial improvement has occurred through the use of microwave, laser, electron beam, and electro-optic surface scanning devices.

4. *New Paint and Undercoating Processes.*—These coatings provide improved anticorrosive and chip-free characteristics, and they are applied within acceptable plant emission levels.

5. *Research & Experimental Equipment.*—Sophisticated equipment such as simulator computers and wind tunnels are now commonly used in contexts that are comparable to such activities in the aerospace industry.

Research and development stages to create a new model

The steps toward the evolution of a new model normally commence with the determination of the need for a product, based on consumer preferences, existing product line (both characteristics and age), and anticipated market strategy. The complexity of the product slows down the subsequent steps as innovation, assimilation, alteration, and improvement come into play. Moreover, for each new product the manufacturer must: (1) attain the lowest tooling cost possible; (2) anticipate and solve future mechanical problems; and (3) give engineering consideration to the problems of shipping, handling and packaging, in order to obtain maximum utilization of storage space. As a result, this evolutionary process may take from six to eight years.

The major steps in a product development program are as follows:

1. *Production Conception.*—At the starting point, the product concept, together with general mechanical specifications, are studied and important dimensions such as wheel base are established. Furthermore, the scope and limitations of the design program are tentatively mapped out. The first sketches or renderings are produced and revised several times until most of the basic design and engineering features have been tentatively determined.

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[7] It is estimated that the industry has incurred a billion dollars of research and development costs for each half mile per gallon improvement in fuel efficiency under CAFE requirements. Since further progress will be increasingly difficult, the projected future costs are expected to rise to a billion dollars for each one-fifth mile per gallon improvement.

2. *Clay Model.*—The next step in the design phase, which normally occurs three to five years prior to commercial production, is the building of the clay model in which the general proportions of the automotive product are developed in all three dimensions.

3. *Initial Drafting.*—Initial drawings are made from the clay model, which are then released to the engineering division for research and experimentation. As soon as basic chassis and body dimensions have been established, the initial design of various components begins. All through this development, changes are made to improve the product and additional alterations may be made as the new model becomes more definite in form and detail.

4. *Mockup.*—Once a mockup of the new model is accomplished, the manufacturer embarks on a pre-prototype phase about three years prior to commercial production to test the fundamental aspects of the new model and resolve any discrepancies prior to further development.

5. *Prototype.*—The prototype phase, which begins approximately 1½ to 2½ years prior to commercial production, is the period in the development of a new automotive product when testing "shakes out" the bulk of the development problems. This is the point in time when the most experimental testing is done. As a result of this process more than one hundered prototype models may be made, normally in series of five to ten units at a time, each series being modified from the prior series based on the test results of the prior series.

6. *Initial Process Development.*—Concomitant with the product development in the prototype phase, the manufacturer undertakes research and experimental activities with respect to the production processes that will be needed to produce the new model commercially. This principally involves tool design and construction of wooden die models which are developed and engineered for testing. New types of equipment are considered and adapted for use at this point.

7. *Pilot Project.*—Approximately six to nine months prior to commercial production, the pilot project is commenced. Both the new product and the attendant production process are brought together to resolve the remaining technical problems in each that is necessary before a finished product and process are finalized.

8. *Job 1.*—Commercial production commences.

9. *Retrofitting.*—Occasionally, research and development must be resumed to solve an unanticipated product problem that surfaces after widespread consumer use.

During the final period of approximately 1½ years prior to commercial production, an extensive amount of design, engineering, component testing, prototype vehicle testing, tool design and engineering, and wooden die design and engineering occur simultaneously. This takes place in a coordinated effort so that changes made in any area may be taken into account in the development of the other. This recognizes, however, that to the extent possible, tooling and tool tryout with respect to commercial production lines may proceed simultaneously with such research and development from the late prototype period all the way through the pilot program.

Similarly, the development of many of the components of the automotive product, although not the automotive product itself, are finished at various points during this period. Due to the severe time constraints involved in such a project, with myriad levels of activity and development, the final pilot project testing and evaluation may, and usually is, completed near the time commercial production must commence; sometimes the phases even overlap. Thus, the automotive product offered by a manufacturer is not a finished product, subject to only economic risks in the market, until essentially the date of Job #1. Moreover, in some instances (as hereinafter described) research and development with respect to an automotive product may be resumed after commercial production to address unexpected performance problems that are identified by widespread consumer use.

Post-Production Research and Development.—In some instances, especially in recent years when the automotive product has changed so drastically on a regular basis, there have been situations in which, despite thorough testing and evaluation by industry and government standards, a performance problem in an automotive product will surface only after consumer use. This results from the fact that a manufacturer cannot feasibly conduct testing on a scale as extensive as actual product use by consumers. When this difficulty surfaces, the automotive manufacturer must conduct additional research and experimentation to identify and rectify the source of the problem. The activities conducted toward this objective are essentially activities which could have been conducted prior to commercial production had the technical problem been perceived.

Technical Improvements to Existing Models.—Existing models are also subject to continuous research and development to effect new technical improvements that are regularly incorporated in them through redesign, engineering, and testing. Such improvements may have been in the development stage for two or three years, or even longer, before they are utilized in commercial products. Timing is important, since this process requires numerous compensating adjustments. In fact, such changes often become quite complicated when the decision to make one improvement triggers the decision to make several other improvements. As previously mentioned, the decision to incorporate a technologically-new bumper system into an existing model may trigger related decisions to redesign the entire front end to improve aerodynamic design, add collision protection, reduce wind noise, increase engine ventilation, and expand road visibility.

Thus, there are multiple research and development steps required to incorporate specific technical improvements, and these steps are normally condensed into one year. This gives rise to substantial costs because of the numerous technical personnel and tests required. The results of this intense development actually may produce what is tantamount to a new automotive product vis-a-vis its predecessor.

ANALYSIS: PROPOSED REG. § 1.174-2 MATERIALLY DEPARTS FROM THE BROAD DEFINITION OF RESEARCH AND EXPERIMENTAL EXPENDITURES IN REG. § 1.174-2 IN CLEAR CONTRADICTION OF CONGRESS' MANDATE IN SECTION 44F

Legislative history

Paragraph (d) of section 44F provides that "the term 'qualified research' has the *same meaning* as the term research or experimental has under section 174." (Emphasis added.) The provision was added by section 221 of the Economic Recovery Tax Act of 1981, P.L. No. 97-34, 95 Stat. 172, 241. MVMA contends that the traditionally broad definition of research and experimental expenditures evident in Reg. § 1.174-2 and implemented in administrative practice, which was confirmed and adopted by Congress in enacting section 44F, has in fact been modified into a more restrictive rule in Proposed Reg. § 1.174-2.

The "legislative history" of section 44F is complicated by the fact that initially the provision was offered in the form of two different proposals in the House and Senate. The bills reported by the Ways and Means and Finance Committees contained significantly different definitions of qualified research. Notwithstanding this, it is clear that by the time the provision cleared the Conference Committee, both Houses intended that, as reflected in the statute, the existing, traditionally broad definition of research and experimental expenditures be continued without modification.

The general definition in the Senate version was equivalent to that finally adopted: "The term 'research and experimentation' has the same meaning as the term research or experimental has under section 174 . . ." See H.J. Res. 266, as reported, 97th Cong., 1st. Sess., § 221, 123, 127 (1981). On the other hand, the original Ways and Means version was significantly different. Instead of incorporating the meaning of research under section 174, the bill formulated a new more restrictive definition. Under the Ways and Means bill, qualified research included research for the purpose of discovering information of potential use in "the development of a new business item" or in "bringing about a significant improvement in an existing business item." Also included was "applying results obtained by research to develop a plan or design for a new business item for the taxpayer, or for a significant improvement in an existing business item of the taxpayer." Qualified research did not, however, include any activity after the point at which the new or improved business item was ready for manufacture, sale, or use.

The Ways & Means explanation of this new definition included several examples of activities that would not qualify. Thus, the Report mentioned the ordinary testing or inspection of materials or products for quality control, efficiency surveys, management studies, consumer surveys, advertising, and promotions. These examples all appear in Reg. § 1.174-2. The House Report went further, however, adding restrictive examples, as follows: routine data collection; routine, periodic, or cosmetic alterations or improvements; routine design of tools, jigs, molds, and dies; construction of copies of prototypes after construction and testing of the original model(s) have been completed; preproduction planning and trial production runs; engineering follow-through or trouble-shooting during production; and adaptation of an existing capability to a particular requirement or customer's need as part of a continuing commercial activity.

These additional examples generally appear to be premised on the requirement that the research and development cause a significant improvement in a business item. The discussion in the House Report seeking to distinguish significant and insignificant improvements is inaccurate, misleading, and misconceived. Moreover, there was no suggestion in the House Report that these examples were reflective of existing law under section 174. *See* pp. 112 n. 4, 115.

The version of the bill adopted by the Conference Committee was that contained in the House-passed bill, H.R. 4242. This bill differed significantly from the original bill reported by the Ways and Means Committee. The provision pertaining to the definition of qualified research in the bill followed precisely the language of the bill reported by the Senate Finance Committee.

The Senate Finance Committee Report,[8] stated at p. 81 that it was adopting the definition of "research and experimental" under section 174, and that it was "anticipated that the Treasury . . . issue *interpretative* regulations [which] . . . will provide additional guidance, *not inconsistent with existing regulations,* defining qualified research for purposes of new section 44F and section 174." (Emphasis added.) The June 22, 1981, Finance Committee release entitled "Bipartisan Tax Reduction Program" stated at p. 15 that,

"[t]he provision adopts the definition of research and experimentation now used under Section 174. While Section 174 does not itself define specifically qualifying research or experimental expenditures, that term has been interpreted by Treasury regulations, Internal Revenue Service rulings, and court cases . . . It is intended that the Internal Revenue Service may, over time, provide further guidance as to this definition *so long as such guidance is not inconsistent with the approach of the existing regulations and administrative practice.*" (Emphasis added.)

The General and Technical Explanation of H.R. 3849, The Economic Recovery Tax Act of 1981, issued on June 29, 1981, by the Treasury Department confirmed that the provisions of section 44F adopt the definition of research and experimentation now used for purposes of deduction of research expenditures under section 174. Moreover, it specifically stated that, "it is intended that the Internal Revenue Service may, over time, provide further guidance as to the definition, *consistent with the existing approach.*" p. 46. (Emphasis added.) This explanation mirrors the statement of Mr. Conable made on introducing H.R. 3849 on the House floor. See Cong. Rec. H2842 (June 10, 1981).

In sum, section 44F adopts the meaning of "research or experimental" under section 174. The bills ultimately passed by the House and Senate were identical in their definition of qualified research. Explanations of these bills issued by the Finance Committee and the Treasury Department prior to the votes by the Senate and the House stated that the section 174 definition as interpreted by I.R.S. rulings and administrative practice, Treasury Regulations, and court cases was being adopted.

These explanations of the enacted bill confirm the clear language of the statute. The statute unambiguously adopts—effectively reenacts—the meaning of "research or experimental" under section 174, and such reference is ipso facto an adoption of the administrative and judicial interpretation of this provision. See *Cammarano* v. *United States,* 358 U.S. 498 (1959). In the case of a simple reenactment of statutory language, it may be uncertain whether Congress was satisifed with existing construction of the statute and intended to adopt such construction. But any such uncertainty is removed when Congress goes beyond a simple reenactment and adopts the meaning of an existing provision in a new provision. Such adoption can only mean that Congress is satisfied with existing interpretation, particularly where, as here, the statutory meaning adopted is little more than the prior administrative and judicial interpretation.

Inaccurate general explanation of section 44F

The letter of transmittal of the General Explanation of the Economic Recovery Tax Act of 1981 prepared by the staff of the Joint Committee on Taxation recognizes that,

"[a] committee report of a Congressional committee sets forth the Committee's explanation of a bill as reported by that committee. In some instances, a committee report cannot also be referred to as an explanation of the final provisions of the legislation enacted by the Congress. This is because the versions of the bill reported by the House and Senate committees may differ signficantly from versions of the bill passed by the House, passed by the Senate, or enacted by a conference committee."

Since the general definition of qualified research passed by the House and the Senate, and adopted by the Conference Committee, is identical to the definition contained in the bill as reported by the Senate Finance Committee, under the reasoning of the letter of transmittal quoted above, the Finance Committee explanation of the definition of qualified research is clearly the most accurate explanation of the law. The Ways and Means Committee Report explains provisions that were not enacted into law. The General Explanation, however, erroneously fails to reflect this critical point.

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[8] See, S. Rep. No. 97-144, 97th Cong., 1st sess. 75-77, 81-82 (1981).

The Joint Committee Staff's description of the definition of research or experimental expenditures under prior law (section 174) lists the items that are included and excluded by the existing Treasury regulation. See p. 119. In its description of the definition of qualifying research under the Act, the staff properly states that section 44F adopts the meaning of "research or experimental" under section 174. See p. 123. Instead of stopping with a description of the section 174 standard, however, the staff goes on to describe certain "nonresearch expenditures." See p. 125. the two paragraphs under this heading were taken virtually verbatim from the Ways and Means Committee Report. As noted above, this description is based on a version of the bill which was not adopted by Congress, and which is at variance from the version that Congress enacted into law.

The inclusion of this description of nonresearch expenses accordingly exceeds the proper scope of the General Explanation—to explain a provision that differs from a provision reported by Committee. Neither does the General Explanation represent a clarifying refinement of a description in a committee report. Rather, it constitutes the incorporation of a definition that Congress *rejected*. Under these circumstances, it is not appropriate to accord the weight that may ordinarily be given to a Joint Committee Staff explanation.

Proposed regulations compared with legislative history

The Explanation of Proposed Reg. § 1.174-2 states that: "The new rules contained in § 174-2(a) are consistent with the explanation of congressional intent prepared by the Staff of the Joint Committee on Taxation." Given that the Joint Committee Staff's explanation of congressional intent is erroneous, this statement undermines the validity of the proposed regulation. Further doubt as to the validity of the regulation arises from the following statement:

"The Internal Revenue Service will not require changes in the treatment of expenses for purposes of section 174 on returns filed before publication of a Treasury decision on this subject merely because of these amendments. However, the amendments will be taken into account for all taxable years for purposes of determining the credit under section 44F."

The foregoing statement is a tacit admission that the proposed regulation seeks to change the existing rules under section 174 in a restrictive direction. If no change were intended, if the proposed regulation simply intends to codify and clarify prior administrative practice and judicial interpretation, it should be applied for all open years.[9] In any event, the selectively deferred effective date of the proposed regulation indicates a departure from the statutory requirement that a uniform rule be applied under section 174 and section 44F.

The contradiction evident in the preliminary explanation of the proposed regulations is corroborated by comparing its content with the Joint Committee Staff explanation and the Ways and Means report. Thus, the exclusions to the general definition in Proposed Reg. § 1.174-2(a)(1) numbered (iv) through (x) are derived from the inapposite explanation in the House Report and the erroneous explanation of the Joint Committee Staff. They do not appear, and are not implied, in either the existing regulations, Senate Report, the Treasury Department General Explanation, or the Finance Committee press release cited above, all of which related to the specific provisions enacted into law.

The restrictive provisions of proposed reg. § 1.174-2 are ineffective and counterproductive

The credit provided by section 44F extends only to the taxpayer's increased research expenses compared with the average expenditures made during the period. The base period consists of one year in the case of the first taxable year ending after June 30, 1981, and thereafter increases to three years. The incremental nature of the credit accomplishes the legislative purpose of stimulating research and development without the risk of substantial unwarranted federal revenue losses.

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[9] "[I]n recent years it has been the administrative practice . . . to exercise the discretion granted under Section 7805(b) by making any changes in Regulations which would act to the detriment of the taxpayer prospective * * * . [A]mendments to the regulations that merely provide certainty as to problems not previously covered by the Regulations or which clarify an ambiguity in existing Regulations are generally retroactive in application." Rogovin "The Four R's: Regulations, Rulings, Reliance, and Retroactivity—A View from Within," 43 Taxes 756, 762-63 (1965).

The traditionally broad definition of research and experimental is compatible with these objectives since an expanded definition would result in a limited revenue loss because of the concomitant expansion of base period expenditures. Indeed, in many cases, a broad definition of creditable expenses will actually raise revenue. Under a broad definition, a taxpayer may show little or no increase in overall research expenditures. If the definition of qualified research is narrowed, however, taxpayers will be encouraged to focus their research efforts on the narrowly-drawn activities—although such activities may not be the most productive use of resources—that qualify under the credit and to concentrate such expenditures in years that will maximize the benefits of section 44F. Thus, even though the taxpayer's total research expenditures may remain constant, qualified research activities may show an increase under a narrowed definition of qualified research.

For example, under a standard that excludes expenditures that are "routine," taxpayers may concede that some of their base period activities were routine, but argue that other current research activities are anything but routine. A minor restructuring of the taxpayer's activities may suffice to make such an argument successful. By contrast, a standard that encompasses all research activities is much less susceptible to this type of manipulation, since minor changes in activity will leave the tax characterization unaffected.

A narrow concept of research and experimental activities would be contrary to the broad general rule embodied in the regulations and practice udner section 174, which has applied to all industries in a uniform manner. Any exclusions to this rule will tend to raise administrative problems and lead to differing treatment of individual industries and companies.

By making the definition of qualified research more restrictive and uncertain, exclusions of this sort tend to thwart the purpose of section 44F, which is to encourage taxpayers to expand their research efforts. Only if the tax treatment of research is certain and easily understood can the tax law exercise a meaningful effect on business planning.

For example, if only costs attributable to "significant" improvements are research and experimental expenditures, this would mean that the success or failure of the research and development would dictate the treatment of such costs. Such a test is unworkable and inappropriate as a policy matter. It is unworkable because success or failure may not be determinable for several years after the expenditures are made with respect to extended projects. It is poor policy because if a taxpayer incurred substantial costs for traditional applied research and development activities which unexpectedly resulted in only a modest technical improvement to a product—because, for example, the technical requirements for the product had changed during the course of the research and experimentation—none of the expenditures would qualify under section 174. The taxpayer would have engaged in precisely the activity sought to be encouraged, but due to extraneous circumstances, would be denied the credit. A luckier, but less energetic, taxpayer might receive full credit for little work that resulted in an unexpected major improvement.

Congress sought to promote a dynamic, new growth of research and development in the U.S.; that can only occur if industry is willing to risk failures in seeking to advance the state of the art. The regulation in its present form will defeat the Congressional objective.

REG. § 1.174-2 AND IRS RULINGS PROVIDE A BROAD DEFINITION OF RESEARCH AND EXPERIMENTAL EXPENDITURES

The scope of section 174 as of the enactment of section 44F

When section 44F was enacted in 1981, the basic boundaries of research and experimental expenditures had been adequately defined by long-standing Treasury regulations and IRS rulings. Research and experimental expenditures are defined under Reg. § 1.174-2(a) as "research and development costs in the experimental or laboratory sense," including, "all such costs incident to the development of an experimental or pilot model, a plant process, product, formula, invention or similar property, as well as the cost of improving an already existing property of the same type." It is noted that there is no limitation on costs designed to produce *some* improvement in the product during the product's formative stage (whether or not successful); i.e., prior to the decision that it is economically feasible to produce the product, as it is, on a commercial scale. Consistent with this, Reg. § 1.174-2(a)(1) expressly excludes from the definition of research and experimental expenditures those costs incurred in the commercial production of the improved product (such as the costs incurred for the ordinary testing or inspection of materials or products for quality control, efficiency surveys, and management studies), as well as any costs incurred in marketing the finished product (such as the cost of consumer surveys, advertising and promotions).

Instructive administrative rulings

Several informative applications of the foregoing principles are evident in a review of some of the published rulings of the Service. In Rev. Rul. 73-275, the question was whether the activities conducted were applied research and development or production processes. The taxpayer designed and fabricated an automated manufacturing system specially designed to meet a particular customer's specifications. The manufacturing system was comprised of a group of known machines, precision machine tools, transfer mechanisms, and related equipment, but it was nonetheless necessary for the taxpayer's product engineering department to develop and design the actual concept of the integrated system through research and experimentation. A commercially workable system was the finished product.

Rev. Rul. 73-275 held that the costs of the taxpayer's product engineering department were research and experimental expenditures even though the product design resulted in the production of only one machine system and there was clearly a functional overlap between the research and experimentation and the actual production of the machine. By implication, Rev. Rul. 73-275, with its careful analysis of the particular facts and circumstances, establishes that differences in research and experimental activities among industries will exist because of the differences in their finished products and the processes through which they are produced.

A close analogy exists in the automotive industry for the research and developmental work performed on its plant processes. Moreover, some specially modified automotive products which may appear to be more than a reconfigured congeries of fairly standard-type components, often are essentially new products which required substantial research and development work to attain the necessary level of component compatibility and efficiency.

Similarly, Rev. Rul. 73-324, 1973-2 C.B. 72, and Rev. Rul. 69-484, 1969-2 C.B. 38, establish by implication that products consisting of several major components, each of which may be individually viewed as a finished product, combined by a series of technical, complicated processes, may become a new product.

Rev. Rul. 74-67, 1974-1 C.B. 63, establishes that the costs of research and development items which are integrally associated with production items may nevertheless qualify as research and experimental expenditures. A taxpayer used conventional mining techniques to drill core holes for geological information regarding underlying ore deposits. The taxpayer also incurred expenditures to perfect a new hydraulic mining technique that utilized water pressure to extract the minerals through both adapted exploratory core holes and separate non-core holes that were drilled to facilitate the mineral extraction. The ruling held that the cost of drilling the core and non-core holes could be recovered under section 615 or section 617 of the Code, but that the additional costs attributable to adapting such holes for use in the design and testing of the new mining process were research and experimental expenditures.

Several letters rulings and technical advice memoranda are consistent with the Service's published rulings. Technical Advice Memorandum No. 8211004 (November 27, 1981), confirms the principle that research and experimental expenditures incurred in producing a final product ready for commercial manufacture qualify under section 174. In that case, a pharmaceutical manufacturer incurred certain costs in establishing to the satisfaction of the U.S. Food and Drug Administration that particular drugs were effective and safe for human consumption. The Taxpayer did not engage in the basic research; it purchased such knowledge and, using applied research and development techniques, carried through with tests in animals and humans for refinement into a finished product certified by the FDA. The Service took the position that all the costs incurred prior to a drug becoming a finished product, certified by the FDA, were deductible as research and experimental expenditures. Significantly, the Service also recognized that some products require extensive testing at several levels, with the attendant consumption or use of numerous prototype units. Moreover, the Service recognized that testing to satisfy goverment-imposed standards is a valid research and development activity, and that a prospective product is not "finished" until it complies with such standards.

In Technical Advice Memorandum No. 8140001 (March 10, 1981), the need of some industries' to construct numerous research and experimental prototypes was recognized. The taxpayer engaged in the manufacture of custom-built rail cars and was required under a contract to design and test a number of prototypes of a new model. The original prototypes did not meet the customer's design specifications. The taxpayer was forced either to construct additional prototypes or re-engineer portions of the original prototypes. The Service recognized that the costs of the taxpayer's continuing activities were research and experimental expenditures.

Similarly, in Private Letter Ruling No. 7948031 (August 28, 1979), a taxpayer engaged in the poultry business continued testing a certain part of an integrated process after completing development of a commercial process to convert chicken manure into animal feed. The taxpayer successfully devised a new technique for extracting unwanted uric acid, phosphates, and other chemicals from the manure. The taxpayer began construction of a full-time processing plant, which incorporated a test facilitiy to experiment with an unproven process for the conversion of the extracted uric acid into fertilizer. Although operation of the processing plant constituted the commercial production of animal feed, the cost attributable to testing the uric acid conversion process were research and experimental expenditures. As in the case of the development of the new hydraulic mining technique in Rev. Rul. 74-67, the research and experimental expenditures retained their character even though they were incurred as an integral part of a larger project that did not qualify under section 174.

RECOMMENDED CHANGES TO PROPOSED REG. § 1.74-2

In view of the foregoing, Proposed Reg. § 1.174-2 needs substantial revision if it is to reflect the actual intent of Congress, facilitate administrative application and, at the same time, ensure equitable treatment to all taxpayers regardless of their type of business.

Attached (Exhibit A) is a suggested substitute draft of Proposed Reg. § 1.174-2 which develops and clarifies the general rule, the exclusions, and the examples to reflect the concerns of the automotive industry.

General rule

1. *Recommended Change.*—We recommend that the language of the general rule in Proposed Reg. § 1.174-2 be changed as follows:

(a) *In general.*—(1) The term "research or experimental expenditures," as used in section 174, means expenditures incurred in connection with the taxpayer's trade or business which represent research and development costs in the experimental or laboratory sense. The term includes generally all such costs incident to the development or improvement of [an experimental or pilot model, a plant process,] a product, *a plant process*, a formula, an invention, or a similar property, *or an experimental or pilot project relating to one or more of the foregoing*. It includes *both basic* research *and experimentation,* [aimed at the] *which seeks the* discovery of new knowledge, and *applied* research *and experimentation,* [for] *which seeks and develops* new applications of either *basic* research findings or other knowledge.

2. *Reasons for Recommended Changes.*—The principal purpose of the recommended changes is to clarify several important points:

a. As proposed, the language implies that the cost of only one model would qualify. It is common in the automobile industry for a number of experimental or pilot models to be produced for testing and evaluation that is clearly experimental in nature. Moreover, the experimental or pilot model may involve a plant process as well as a product. The Service has recognized the qualification under section 174 of similar expenditures in analogous contexts in Rev. Rul. 73-275, 1973-1 C.B. 134, and, implicitly, in Rev. Rul. 69-484, 1969-2 C.B. 38, Rev. Rul. 73-20, 1973-1 C.B. 133, and Rev. Rul. 73-324, 1973-2 C.B. 72. Consequently, it is our recommendation that, consistent with past administrative practice, the definition be changed to include an experimental or model project, and that such language be placed at the end of the sentence so that it will refer to any of the listed qualifying activities which precede it.

b. As proposed, the description of research does not use the commonly understood terms, "basic" and "applied". In addition, only the first sentence of the definition expressly acknowledges the qualification of development costs as research and experimental expenditures. We recommend the addition of the underlined language to enhance generally the definition of "research and experimental" and to clarify the qualification of development activities. These suggested changes are consistent with the existing regulation and administrative rulings. See, Rev. Rul. 74-67, 1974-1 C.B. 63 and Rev. Rul. 75-122, 1975-1 C.B. 87.

Several other concepts should be considered when analyzing the General Rule.

Applied research and development.—In general, there should be no dispute that all costs related to basic research and experimental activities meet the test of section 174. The qualification under section 174 of expenditures for *applied* research and development conducted primarily to design, engineer and test a new commercial product or process, should be equally as clear. The Proposed Regulation should recognize that research and experimental costs for product development in the context of an industry with complex products or production processes may require extensive testing at several levels of development prior to the attainment of a finished commercial product. Only when such product needs no further technical development and, thus, is subject only to the economic risks of commercial manufacturing and marketing, does this process end. In this context, it is probable that some components of a complex product may achieve finished status before other such components, with the result that the overall product is not finished until essentially all components reach such status. Support for this approach, as consistent with the existing regulations, is evident in several administrative rulings. See, Rev. Rul. 75-122, 1975-2 C.B. 87; Rev. Rul. 74-67, 1974-1 C.B. 63; Rev. Rul. 73-275, 1973-2 C.B. 134; LR 8211004; LR 8140001; and LR 7948031.

Post-commercial production research and experimentation.—It is anticipated that research and experimentation costs would rarely occur with respect to a particular product after its commercial production begins. Sometimes, however, research and development with respect to a particular product must be resumed after commercial production has commenced because of the identification of an unanticipated product difficulty. In such case, the additional costs of testing, analysis, design, and engineering necessary to correct the problem are indistinguishable from the research and experimental expenditures allowable before commercial production occurs. This is analogous to the concept in LR 7948031, in which it was recognized that although one phase of a waste recycling process plant was commercially operable, this did not preclude the treatment of costs to continue development of an attendant process as research and experimental expenditures.

General rule—Specific exclusion

1. *Recommended Changes.*—The introductory sentence should be amended to add at the end thereof, "the costs of—".

The listing of specifically excluded items should be changed as follows:

(i) No change.

(ii) No change.

(iii) No change.

(iv) [The rountine periodic or cosmetic alteration or improvement (such as seasonal design or style changes) of] *Changes or alterations in* existing products, [commercial production lines, or other ongoing operations,] *solely for appearance or similar aesthetic reasons*;

(v) *Changes or alterations in existing plants or production lines related to product changes or alterations described in clause (iv), unless such change results in a technical improvement*;

(vi) [The routine e] Design *and construction (but not adaptation)* of tools, jigs, molds and dies-, *built and used in commercial production lines*;

(vi) [The construction of copies of prototypes after construction and testing of the original prototype has been completed.]

(vii) Planning *and installing* for commercial production *lines*; and trial production runs-, *on such commercial production lines*;

(viii) Engineering follow-through or troubleshooting *of production line processes* during commercial production;

(ix) [The adaptation of an existing capability to a particular requirement or customer's need as part of a continuing commercial activity,] *Combining standard parts in a series of configurations to fabricate different products designed for particular uses of different customers when such activity does not involve additional design, engineering or testing to accomplish component compatibility and efficiency*;

(x) No change.

(xi) [The costs of acquiring] Acquisition of another person's patent, model or production process.

2. *Reasons for Recommended Change.*—The recommended change to the introductory sentence is made for purposes of consistency and clarity. It is the costs of the activities that do not qualify under section 174. The recommended changes to the enumerated exclusions are intended to clarify that under the existing regulations and administrative practice, the costs of seeking and developing any technical improvement to a product is a research and experimental expenditure. They are also intended to reflect that although a broadly uniform, general rule is necessary and desirable, specific exclusions to such general rule may have unsuspected and quite discriminatory effects when applied across the board. Specific exclusions will produce different effects across industry groups due to substantial differences in the manner and type of research and development done as a result of the nature of the

product or the process involved and the structure of the industry and its markets. Such exclusions must be stated in a manner which avoids any such discrimination.

Proposed clause (iv) uses the words "routine", "periodic", and "seasonal design or style changes" to describe improvements to existing products that were apparently considered part of the production and marketing processes rather than the research and experimental process. It creates the impression that the costs attributable to recurring or periodic technical improvements to existing products are not research and experimental costs, which is simply incorrect. It also implies that recurring or periodic technical improvements are presumed to relate to appearance changes, which is equally incorrect and misleading.

If the indicated terms are given their usual meaning, proposed clause (iv) will unfairly discriminate against the automotive industry. The multi-year cycle of design, engineering, testing and production discussed above reflects the fact that automotive products are complicated, and that they are manufactured by a complex and extensive process. Improvements continually are made in an automobile model from time-to-time after its commercial introduction. These improvements occur as a result of continuing research and experimentation. For example, engine monitoring and control are two functions that have been substantially expanded and improved during the past five years with the introduction of integrated circuitry and other related technologies to automotive vehicles. Improved aerodynamic design and the use of alternative materials have consistently improved fuel efficiency and crash protection in automotive vehicles. The incremental nature of these technical improvements does not preclude their costs from qualifying as research and experimental expenditures.

Results need not be dramatic or major advances in the state of the art in order for the costs to be research or experiemental costs. Steady, cumulative increases in technology, built one upon another, may equally reflect research and experimentation activities advancing the state of the art. Some industries, such as the automotive industry can only advance technologically in this way.

The focus of clause (iv) seems to be on product changes that effect appearance rather than the technical aspects of the product. As discussed earlier, Reg. § 1.174-2 does not contain the distinction between a "significant" and an "insignificant" product change, and we do not read this example as establishing such a test. Thus, the example should be clarified by specifying that it is that costs of aesthetic changes in products that do not qualify under section 174. Whether such costs are routine or periodic is irrelevant; it is their characterization as production or marketing costs that disqualifies them.

Proposed clause (iv) also dealt with production processes. For added clarity, we recommend deleting production processes from clause (iv) and adding a new clause (v) to complement clause (iv) with respect to changes in the production processes that are related to costs of product changes that are disqualified by recommended clause (iv). It should be noted, however, that the costs to develop a new process or technique to accomplish the product changes in clause (iv) qualify as research and experimental expenditures.

Proposed clause (v) (recommended to be renumbered to clause (vi)) appears intended to disqualify expenditures which should be capitalized into equipment accounts and depreciated or amortized. We recommend clarifying the clause so that it operates to isolate the design and construction costs of the tools, jigs, molds and dies built and used in the commerical production line from the costs of such items used for research and experimental purposes, including pilot plant projects. Changes in the design of parts of the automotive product which occur during the design and construction of production tools to accommodate efficient manufacture and installation of such parts *are not* included in such disallowed costs.

Proposed clause (vi) should be deleted because it is inconsistent with the longstanding application of section 174 to the automotive industry, which conventionally builds large numbers of vehicles at various stages of the experimental testing process that are prototypes of the new model ultimately developed for manufacture and sale. These prototype vehicles have no serial numbers and may not be held for sale or private use. One vehicle may be built to test a new powertrain, but the exterior may be last year's model; another may be built to test suspension or ride characteristics, and it may have the new model's interior, but last year's exterior and powertrain. Even when all the myriad parts of the new model are combined into a single prototype, effective testing for government regulatory requirements, such as fuel efficiency, safety and emissions standards, requires several prototypes. It is significant that a recent technical advice memorandum (LR 8110004) clearly recognizes that some industries must conduct numerous tests which require the manufacture and use of many product (prototype) units during an extended test period. The need to satisfy predetermined government standards for reliability, which is also a major consideration in the automotive industry, was an important factor in the ruling. In the case of complex product manufacturing, such as for automobiles, such a clarification is essential for fair treatment.

Proposed clause (vii) also appears to be intended to eliminate the design costs of commercial production lines from treatment as research and experimental expenditures. Clearly, such costs should be capitalized, but a more accurate description of such costs should be provided. The recommended changes combine the word "planning" with "installing" to insure that the design and engineering of pilot plant processes, which look toward commercial production lines, is not an excluded activity. Under the recommendation, the capital nature of the cost would be the focus of the test contained in the clause.

Proposed clause (viii) seems intended to draw a line between research and development on the one hand, and engineering support of commercial production on the other hand. We recommend changing clause (viii) to clarify that the excluded activities described generally as "trouble-shooting" are technical services related to commercial production.

Proposed clause (ix) is susceptible of an unduly broad interpretation if it may mean that the application of existing capability to meet a governmental requirement, for example, is not research and experimentation. It is clear that applied research and development is covered by section 174. These activities necessarily involve the application of knowledge to particular new or improved products and production processes. On the other hand, there is no disagreement that if components 1, 2 and 3 can be assembled in one configuration for customer A, and another configuration for customer B without the need for additional design, engineering or testing for component compatibility and efficiency, such work is in the nature of commercial production rather than applied research or development. Consequently, we recommend rewording proposed clause (ix) to clarify this basic distinction.

Proposed clause (xi) is only editorially changed.

Examples (1) to (5)

1. *Reason for Recommended Change.*—Examples (1)-(5) use hypothetical automotive industry situations to demonstrate the general rule and specific exclusions. In general, the examples reflect a greatly oversimplified view of the automobile design and manufacturing process, as described more fully above. Actually, the automotive industry may be sufficiently unrepresentative of other industries that Treasury should consider eliminating the examples altogether. As previously indicated, since industry research and development practices vary so significantly, a specific general description of research and experimentation is inappropriate. Thus, application of these examples to other industries may confuse more than clarify, and they, perhaps, should be entirely deleted on that ground.

If the examples are retained, however, their hypothetical facts must conform to reality for them to be meaningful. The indicated changes to the examples are intended to demonstrate application of the suggested general rule and exclusions to actual facts.

2. *Explanation of Recommended Changes.*—In Example (1), the facts have been changed to describe the general industry practice of producing both all new models and technical improvements to existing models. As changed, Example (1) will effectively require a segregation of the cost of appearance or aesthetic alterations to existing models. Accordingly, there will be no need for controversy about what is incidential and routine.

In Example (2), the facts have been changed to indicate that automobile bodies are not determined solely on the basis of appearance considerations; rather the unitized body now in use is the principal structural component of the automobile and it serves several other essential functions.

In Example (3), a distinction has been drawn between production process changes that constitute research and development and those that do not.

In Example (4), the application of the rule for post-commercial production research and experimentation is demonstrated.

CONCLUSION

In its current form, Proposed Reg. § 1.174-2 introduces new, restrictive rules and concepts in its "revised" definition of research and experimental expenditures. This narrowed definition is contrary to the clear intent of Congress when Congress enacted section 174 in 1954 and, subsequently, in 1981 when it enacted section 44F. This new definition of research and experimentation is ambiguous, administratively unworkable and, perhaps inadvertently, it reflects several policy considerations that are unsound and highly inadvisable from the standpoint of encouraging research and development activity. Accordingly, the MVMA strongly urges that Proposed Reg. § 1.174-2 be withdrawn, revised, and reproposed for additional comments before being published in final form.

EXHIBIT A.—MVMA SUGGESTED SUBSTITUTE FOR PROPOSED REG. §174-2

§ 1.174-2 Definition of research and experimental expenditures.

(a) *In general.* (1) The term "research or experimental expenditures," as used in section 174, means expenditures incurred in connection with the taxpayer's trade or business which represent research and development costs in the experimental or laboratory sense. The term includes generally all such costs incident to the development or improvement of a product, a plant process, a formula, an invention or a similar property, or an experimental or pilot project relating to one or more of the foregoing. It includes the costs of both basic research and experimentation, which seeks the discovery of new knowledge, and applied research and experimentation, which seeks and develops new applications of either basic research findings or other knowledge. The term does not include the costs of—

(i) Efficiency surveys or management studies;

(ii) Consumer surveys (including market research) or market testing and development (such as advertising or promotions);

(iii) The routine or ordinary testing or inspection of materials or product for quality control;

(iv) Changes or alterations in existing products solely for appearance or similar reasons;

(v) Changes or alterations in existing plants or production lines related to product changes or alterations described in clause (iv), unless such change results in a technical improvement;

(vi) Design and construction (but not adaptation) of the tools, jigs, molds, and dies built and used in commercial production lines;

(vii) Planning and installing commercial production lines, and trial production runs on such commercial production lines;

(viii) Engineering follow-through or troubleshooting of production line processes during commercial production;

(ix) Combining standard parts in a series of configurations to fabricate different products designed for particular uses of different customers when such activity does not involve additional design, engineering or testing to accomplish component compatibility and efficiency;

(x) Routine data collections; or

(xi) Acquisition of another person's patent, model, or production process.

However, the term includes the costs of obtaining a patent, such as attorney's fees expended in making and perfecting a patent application.

(2) Research and experimental expenditures may relate to products, to plant or production processes or to a combination of the two.

(i) Product-Related Research and Experimental Activities—Product-related research and experimental activities include all activities directly related to the conceptual formulation of a new product or technical improvement of an existing procuct through the design, construction, and testing of all prototypes necessary to develop a finished product concept which, except for de minimis modifications, needs no further technical developmemt and is essentially ready for commercial production. Testing means the application of scientific testing or evaluation methods either in a laboratory or outside a laboratory under conditions susceptible of technical observation. Testing may involve activities related to the satisfaction of government, manufacturer or market imposed performance or other specifications.

(ii) Process-Related Research and Experimental Activities—Process-related research and experimental activities include all activities from conceptual formulation through the design and testing of new or improved plant or production processes. Such activities also include the preparation of formulas, specifications, standard practice instructions, operating manuals and the like for application of plant or production processes. It does not include the cost of construction and installation of the equipment and related items, production costs, or the costs of developing market information.

(iii) Post-Pilot or Prototype Research and Experimental Activities—After the commencement of commercial production of a new or improved product, performance problems may be discovered which must be rectified through further research and experimental activities. Similarly, in some situations new or improved products may require additional costs for significant new or improved production processes, and additional research and experimental activities may be conducted with respect to such production processes. Such activities are essentially the same as those research and experimental activities that occurred prior to commercial production. In such situations, the related costs of such post-production research and experimental activities will be considered allowed expenditures.

3. *Examples.*—The following examples illustrate the application of the principles contained in subparagraphs (1) and (2) of this subparagraph.

Example No. 1.—An automobile manufacturer traditionally introduces a new line of automobiles every year. The new line may have both new models and existing models with technical improvements as well as appearance changes. All the costs of designing, engineering and testing the new automobile model and the related production processes are allowed research and experimental expenditures. The new technical improvements incorporated in an existing model include electronic engine monitoring equipment and a new hydraulically-operated sun roof. The costs of the research and experimental activities relating to the incorporation of such improvements into the existing automobile models are allowed research and experimental expenditures. The appearance changes incorporated in an existing model include alteration of the chrome body or interior trim and hudcaps made solely for aesthetic purposes. None of the costs associated with accomplishing these appearance changes are allowed research and experimental expenditures.

Example No. 2.—The facts are the same as in Example No. 1. In addition, the manufacturer also performs research to discover whether light-weight alloys can replace steel in a high-stress position in the automobile. The costs associated with these activities are allowed research and experimental expenditures.

Example No. 3.—The facts are the same as in Example No. 1. In addition, the manufacturer develops a process for spraying a new type of chip-free, non-fade paint on the new line of automobiles, and also rearranges the configuration of machines which process and attach the reshaped chrome trim for installation on the manufactured automobiles. The cost of the activities which relate to the development and incorporation of the new paint process into the overall production process are allowed research and experimental expenditures. None of the costs of the reconfiguration of the machines to process and attach the trim on the commercial production line are allowed expenditures.

Example No. 4.—A manufacturer develops a new or improved product which after reasonable testing by industry and government standards, appears ready for commercial production and sale. Subsequently, after manufacture and marketing of the product have begun, it becomes apparent through consumer use that the product has a performance problem. The manufacturer performs additional research and experimentation to design and engineer a technical improvement to solve the problem in the product, which will then be recalled and retrofitted. The research and experimental activities associated with designing and engineering the technical improvement to the recalled product give rise to allowed research and experimental expenditures.

(4) Generally, the cost of developing computer software.

Mr. PICKLE. Thank you, Mr. Nolan.

When you say represent the National Motor Vehicle Association——

Mr. NOLAN. Yes, Mr. Pickle.

Mr. PICKLE [continuing]. I assume this means General Motors, Chrysler, Ford, and all the other related companies?

Mr. NOLAN. A number of other companies who produce trucks and buses as well.

Mr. PICKLE. I would be particularly interested in knowing, from the members of your association, how much they use R&D. A breakdown of each one of those companies, to let us know what years you claimed the credit and in what amount, starting in 1981, would be helpful.

Mr. NOLAN. We would be very happy to present that information.

Mr. PICKLE. I would like to have that, and perhaps the specific type of research activities for which these various firms claimed the credit.

Mr. NOLAN. I certainly will do that. I would like to point out just in passing that we have done an extraordinary amount of basic research in areas that are not well known to the public, such as the causes of acid rain, the way to deal with acid rain, and the miniaturization of electric motors, which have tremendous value throughout American industry, not just in automotive applications but in a wide variety of basic research projects of that nature.

Mr. PICKLE. That is interesting. I did not know that. I would assume, though, upon reflection, that you would, but I did not realize that had been part of your research programs.

Let me ask you a little bit more specifically with respect to the direct automobile business. To what extent should the tax credit apply to annual car model changes or design changes? For example, the General Accounting Office testified to our committee that this credit was claimed on auto trim and auto brakes.

Mr. NOLAN. Well, we recognize that there is a need to distinguish in the allowance of R&D expenditures between developments that are functional in nature, which really improve the capacities of the product or its fuel efficiency or its safety abilities, and those which are purely stylistic in nature. And the general effort in the automotive industry has been to claim the credit for those expenditures which are regarded as advancing the quality of the product itself, which have functional improvements in the product.

Mr. PICKLE. You didn't either affirm or deny the fact that you did claim these credits for, say, auto design. Are you doing that?

Mr. NOLAN. Yes; in some respects auto design is a very functional feature of the automobile. There have been design changes which have had very substantial effects on fuel efficiency, and to the extent that——

Mr. PICKLE. Would that apply for car models, too, just the model?

Mr. NOLAN. Well, it depends upon whether the expenditure is directed at improving the functional capacity of the product on the one hand or simply a stylistic change on the other hand. We have to draw those distinctions.

Mr. PICKLE. Well, there is a distinction between what is R&D in the broad field and what you just normally do to change the style from one year to another. You are going to be doing that anyway.

Mr. NOLAN. That is correct.

Mr. PICKLE. So I think there is a sharp line there that we must be mindful of.

Mr. NOLAN. We have tried to draw that line.

Mr. PICKLE. Let me ask you another question, since you brought it up. To what extent are auto firms claiming the research and development credit and then using that technology overseas?

Mr. NOLAN. Well, we do not have much occasion to use the technology overseas. We are focusing upon the domestic automobile market. That is what we are trying to recapture in our business. That is where our research is directed.

Mr. PICKLE. Are you saying that you do not perform R&D and then use that technology overseas?

Mr. NOLAN. I could not make an absolute 100 percent assertion to that effect, but in general the focus of our R&D activities are improving the quality and functionality of domestic products. In other words, it is focused in the United States.

Mr. **Pickle**. I understand that, but the automobile business today is just like high tech; it is everywhere.

A couple of years ago I was with a trade group and we went to Singapore and they wanted to know if we wanted to see one of the largest businesses in Singapore, and I said yes. I went to see that business and found out it was Texas Instruments.

So your automobiles like high tech products are not just manufactured here and then you keep them under your tent in the United States.

Mr. **Nolan**. Mr. Pickle, the great bulk by far of automobiles that are produced in the United States are sold in the U.S. market.

Mr. **Pickle**. Yes, I would assume that.

Mr. **Nolan**. They are not exported abroad for sale.

Mr. **Pickle**. I am just simply trying to establish to what extent, if any, or in what percentage, that is being practiced. Because we would have some reservation about the credit being given here if you shove the benefit overseas.

Mr. **Nolan**. We will provide a specific answer to that question.

Mr. **Pickle**. All right. Now, we are going to ask you, in the interest of time, some of these other questions. You may submit your answers to us later.

Thank you, sir, very much.

[The following was subsequently received:]

Miller & Chevalier,
Washington, DC, October 12, 1984.

Hon. Charles B. Rangel,
Chairman, Oversight Subcommittee, Committee on Ways and Means, Longworth House Office Building, Washington, DC.

Dear Mr. Rangel: The purpose of this letter is to provide additional comments concerning the R&E tax credit on behalf of Motor Vehicles Manufacturers Association (MVMA). These comments, initially due September 17, 1984, and informally extended to October 15, 1984, are made in response to questions that Congressman Pickle asked me at the Subcommittee hearing on August 2, 1984, and a written list of eight questions that the Subcommittee staff enclosed with the transcript of my testimony.

At that hearing, I testified on behalf of MVMA in support of making the R&E tax credit permanent and clarifying the definition of "qualified research" so as to remove any doubt that certain applied research and development activities conducted by the automotive industry qualify for the R&E tax credit.

MVMA's responses to the eight questions of the Subcommittee staff (which subsumed the questions asked by Congressman Pickle) are as follows:

(1) *Use of the R&E tax credit (years and amounts claimed).*—MVMA has ten members. The precise amount of R&E tax credits claimed by each member of MVMA is available to the Committee from the member companies' income tax returns.

Moreover, three member companies recently supplied that information to the General Accounting Office in connection with a survey on R&D conducted for the Committee. As you can appreciate, these data are confidential and are potentially important competitive information. For antitrust and other reasons, this information is not shared among MVMA members.

In general, the R&E tax credits earned by all member companies during the three years 1981 through 1983, averaged about $58 million a year. The amount of tax credits used during such years averaged approximately $40.9 million a year, the balance being carried over to other years. The total tax credits claimed decreased between the years 1981 and 1982, but increased substantially over both such years during 1983. Some members have not been able to take advantage of the credit due either to net operating losses or failure to exceed the base level of expenditure during some or all of such years.

(2) *Specific types of research activities and the nature of the research (i.e., basic, applied, development, product improvement or new product).*—MVMA member companies conduct basic research in a broad range of areas including materials, manu-

facturing processes and performance functions with respect to automotive products. Examples include: Materials—development of elastomeric filaments for automobile seats, graphite and ceramics for engine blocks, and sophisticated plastics for wheels; Manufacturing Processes—development of new techniques for electroplating plastics, brazing aluminum, and robot safety systems; Product Performance Functions—development of redesigned engines which operate with less friction, stronger more durable electric batteries, and aerodynamic vehicles to reduce wind drag and noise.

Some member companies also conduct basic research in areas that are not restricted to use in the automotive industry. Examples include, research on acid rain, waste plastics recyclying, optical systems and micro computers.

MVMA members also engage in both applied research and development activities to improve their existing automotive products and to develop new automotive products. This is the principal focus of their research and development activities because it is essential to their economic survival in the world automotive market. See answers to questions 4, 5, and 8, below. Examples of recent efforts include development of new rapid defrost windshield systems based on advanced electrofilm technology, electric power steering systems, miniaturized electric motors, electronic equipment to monitor automobile performance (as well as driver performance) and maintenenace, and multiplex optical fibers to replace electrical wiring.

(3) *The final product or process to be affected or created.*—MVMA's members focus their principal efforts in the research and development areas of improving functional performance or manufacturing processes with respect to several types of motor vehicles, including trucks, automobiles, buses, and similar vehicles. These research activities focus on both specific automotive components and manufacturing processes, as well as overall performance and manufacturing processes for new or improved vehicles. The highly complex nature of both automotive products and their manufacturing processses require a comprehensive approach to research and development.

(4) *Treatment of research and development activities if the credit had not been available.*—The research and experimental tax credit has had a significant impact on the automotive industry's research and development activities. It is an important influence that has encouraged and assisted the substantial expansion of automotive research and development in recent years.

The entire United States automotive industry is subject to intense competitive pressures due to several influences, including rapid changes in the technology incorporated in its products, changing customer expectations with respect to automotive products, federal regulations and competitors from foreign countries, several of which encourage research and development through tax credits, government sponsored R & D programs or direct subsidies. Thus, the industry has continuous pressure to conduct research and experimental activities to maintain or improve its competitive position. Each new technological improvement enhances industry product lines and strengthens the industry.

Some industry members recently curtailed their overall research and development activities, particularly their more venturesome projects, due to a lack of budgeted funds. Other members with greater financial resources have increased their research and development activities despite the adverse conditons in the domestic automotive industry.

There are always areas which an industry member recognizes as deserving additional research to advance product performance beyond the current state of the art. Nevertheless, the annual expenditure that a member makes for research and development activities is a budgeted item, as any other operating expense, and ultimately the cost-benefit ratio of the activity must be weighed against the risks of success and the resulting enhancement to the member's product line. The R & E tax credit has the effect of decreasing the net cost of undertaking research and development activities, and the members take this into account in determining the amount of research and development expenditures that they can afford to budget each year.

For both the financially weaker and stronger elements of the industry, the R & E tax credit provides important encouragement to increase research and development activities. The credit also makes them more financially able by decreasing the costs of such activities. The incentive of the credit operates automatically and indirectly to encourage funding for needed research and development projects.

(5) *Research and experimentation activity which was undertaken primarily because of the benefits available under the R & E tax credit.*—MVMA's members are all continuously engaged in automotive product research and development. The availability of internal funds and the ability to use the R & E tax credit currently are two important factors limiting the incentive effect of the credit, as well as the incremental nature of the credit. Other market factors such as the need to stay competitive

with the research and development of foreign rivals, the need to make complementary changes to related product components or manufacturing processes, and the need to reduce costs and improve functional performance all are taken into account in determining the amount of funds that can be budgeted for research and development. The availability of the R & E tax credit provides a positive threshold stimulus to increased funding for undertaking additional threshold stimulus to increased funding for undertaking additional research and development beyond that which is essential for short-term survival in the world automotive market. By reducing the cost of research activities, the credit stimulates a higher level of activity than would otherwise occur.

(6) *The amount and types of expenditures reported as "qualified" expenditures in claiming the R & E credit but not included as research costs in reports made to the SEC.*—MVMA members, separately and as a group, claimed only a fraction of their research activity expenditures reportable to the National Science Foundation and Securities Exchange Commission as expenditures qualifying for the R & E tax credit. Section 44F (now section 30) of the Internal Revenue Code requires all taxpayers to define research and development for the R&E tax credit more narrowly than the other similar definitions concerning these types of such expenditures. There is no instance in which expenses treated as eligible for the credit have been excluded from any other definition of R & D expenditures.

The data requested are commercially sensitive and confidential in the same manner as the data requested in question 1 above. With respect to the automotive industry, however, examples of significant variances between SEC reporting and tax reporting can be illustrated. Thus, overhead costs clearly essential to research and experimental activities are excluded from eligibility for the R & E credit, but are included in R & D expenditures for SEC reporting purposes. More specifically, one member maintains a large facility which is used exclusively for research and which has a substantial group of technical personnel for implementation and trouble shooting duties, as well as the general management of R & D programs. These experts are critical to the success of the member's R & D efforts. Yet, this laboratory reported expenditures only 60 percent of which qualified for the R & E tax credit, while the entire amount qualified as R & D reported to the National Science Foundation. Consistent with this, several large members substantially involved in R & D activities have determined that their 1983 R & D expenditures ranged from approximately 165 percent to 212 percent of the total amounts that qualified as R & E expenditures under section 44F.

(7) *Effect of a permanent R & E tax credit on long-range research budgeting and planning.*—A short-term, temporary R & E tax credit creates uncertainty about its future, which increases the probable net costs of longer term research and development projects.

On the other hand, a permanent R & E tax credit would provide a favorable, long-term environment for the future conduct of increased research and development activities. A permanent R & E tax credit would permit members of the automotive industry to be more certain with respect to the costs that they bear for research and development. Longer term more costly and higher risk research and development would be more attractive because the industry could rely on the federal government's indirect sponsorship of some of the research costs.

The R & E tax credit operates in a manner similar to the investment tax credit. It has an effect on domestic research and development much like the ITC affects capital investment decisions; both generally encourage the intensification and acceleration of planned and existing projects and activities. The desire to become stronger competitively is already in place to encourage companies to expand their activities. The tax credits make it easier and more feasible financially to pursue such objectives more vigorously.

(8) *Effect of excluding development expenditures from eligibility under the R & E tax credit.*—MVMA would strongly object to the exclusion of development expenditures incurred to produce new or improved products from the R & E tax credit. This would ignore an important purpose of the R & E tax credit: i.e., to ensure that United States industry achieves and maintains technological competitiveness in domestic and world markets.

Excluding development costs from the R & E tax credit would leave a substantial, costly, and risky gap in the evolution of new products and processes. Technological advances from basic research must be translated into specific new or improved products to realize the benefits of new technology, Experimental development of products, which does not include debugging and startup engineering for proven commercial products and manufacturing processes, is technically risky and expensive.

Thus, product and process development are critical to attaining the goal of industry competitiveness. Indeed, a principal finding of the President's Commission on Industrial Competitiveness was that U.S. industries are typically less effective in translating new technological advances into commercial reality than their foreign counterparts. This is due in part to stringent government regulation and other financial and operational constraints in several U.S. manufacturing industries. Evidence of this problem is reflected in the recent National Science Foundation Report (National Patterns of Science and Technology Resources—1984) which discloses that both private industry and the federal government have continued to increase their development costs. The report recognized that industry accounts for nearly 90 percent of development costs, which are closer to production. The report also recognized that development is the most expensive area of R & D work.

On the other hand, the United States has always been a leader in producing new ideas and technologies through basic research. Basic research also enjoys direct financial assistance from foundations and government research grants, while applied research and development are not similarly benefitted. For this reason, applied research and development are the very areas which most require the sponsorship provided by the R & E tax credit.

Should you have any other questions, please contact us.

Respectively submitted.

JOHN S. NOLAN.

Mr. PICKLE. Now we want to hear from the Electronic Industries Association. Mr. Peter F. McCloskey is president, and you are accompanied, I understand, by Mr. Richard Irwin, chairman of the Tax Council.

STATEMENT OF PETER F. McCLOSKEY, PRESIDENT, ELECTRONIC INDUSTRIES ASSOCIATION, ACCOMPANIED BY RICHARD F. IRWIN, GENERAL TAX COUNSEL, INTERNATIONAL TELEPHONE & TELEGRAPH CORP., AND CHAIRMAN, EIA TAX COUNCIL

Mr. McCLOSKEY. Thank you, Mr. Chairman.

You have my written testimony. I will just try to answer a couple of questions that have been raised this morning and this afternoon. First, I suppose——

Mr. PICKLE. First, you are for making this credit permanent?

Mr. McCLOSKEY. I am for making it permanent, and I think the thousand companies that we represent in the electronic industries in our 60th year are for it as well.

I think one of the points you just made, about R&D technology used offshore that they are getting credit for here, is a good one to look at and to do some thinking about. I would say it is definitely in the best interest of the United States to encourage our companies to do their research and development here, even if the product of it is then used overseas to increase and amplify sales through locations overseas. A vast majority of the R&D is used to sell a product overseas from our plants here. Our factories do a highly intensive export business.

But despite that, in 1983 we swung from about a $3.3 billion surplus to a negative trade balance, and that includes high technology electronics. Now, that signifies several things. One, of course, is that the high value of the dollar, the attractiveness of the U.S. market, and the expansion that we were undergoing are sucking imports in.

But another is the very, very competitive business that we are in. As was mentioned by Congressman Shannon, both in Japan and West Germany, the tax credit for research and development is recognized as permanent. That, I think that a very definite pull effect, if you will.

Companies engaged in multinational business have an option as to where to conduct their research and development. We corrected, at least temporarily, the 861 issue that related to that. However, our R&D tax credit is another significant incentive to companies toward keeping their research and development in the United States rather than doing it overseas.

The point that was made by Congressman Shannon is excellent. Over the decade preceding the enactment of this credit as a part of ERTA, we had experienced a reduction in R&D as a percentage of gross national product—from 3 to 2.3 percent—at the same time that both West Germany and Japan were increasing R&D as a percentage of their GNP.

I concur with some of the points that were made earlier today—to the effect that companies investing in research and development do not necessarily get the full benefit themselves, and that society is certainly a beneficiary. One industry can well be the beneficiary. They themselves may create innovation in areas that benefit other industries. And so you cannot look solely at the direct benefit.

You mentioned that you recall, as do your colleagues, that it was originally argued that in the long run the tax credit was actually going to raise revenues. I think that argument is particularly valid in the research and development area.

Dr. Mansfield, who was cited earlier, was really the seminal reason why I suggested 4 or 5 years ago, that we ought to get a tax credit for research and development. He pointed out the pass-through to productivity in our society that comes through innovation, and that a large portion of that innovation comes directly from research and development—whether it is utilized in the industry that performed the research and development, or whether it passes to society by means of technology transfer or educational system.

I do not think there is any question, but that we, as a society, ought to encourage research and development. The increased emphasis on research and development that has occurred in the last several years is necessary in order for us to meet competitive challenges worldwide. The steps that we have taken in that direction have been of major assistance to U.S. companies operating here.

So we go on record as firmly in favor of making permanent the research and development tax credit, and of making corrections to it where appropriate to clarify problems that are apparent today.

[The prepared statement follows:]

STATEMENT OF PETER F. MCCLOSKEY, PRESIDENT, ELECTRONIC INDUSTRIES ASSOCIATION

I am Peter F. McCloskey, President of the Electronic Industries Association ("EIA"). Accompanying me is Richard F. Irwin, General Tax Counsel of the International Telephone and Telegraph Corporation, and Chairman of the EIA Tax Council.

1984 marks the 60th Anniversary of EIA. With more than 1000 participating companies, ours is the full-service national trade association representing the entire spectrum of U.S. companies manfacturing electronic products. These include components, equipment, and systems; they are made for industrial, governmental, and consumer end-uses.

Mr. Chairman, your announcement of this hearing posed eleven question. I will address six of them in my testimony and, with Mr. Irwin's assistance, attempt to answer subsequent questions that your Subcommittee might pose.

Your Question #1 was: Should the tax credit's provisions be allowed to sunset, should they be extended, or should they be made permanent?

EIA recommends very strongly that they be made permanent.

There is much bipartisan support for increased R&D. It figures prominently in the 1984 Democratic Platform. It was accorded prominence in President Reagan's 1984 State-of-the-Union message.

As Japan and a score of other nations compete aggressively with American manufacturers for shares of our home and export markets, our technical superiority has become the margin of leadership. R&D generates technical superiority, innovative products, and improved productivity.

In the 1981 law, you gave industry a real incentive to invest a bigger share of its earnings in R&D. Government sent our companies a message that it supports their expenditures for research and experimentation, and regards them as important to the vitality of this nation.

In recommending, now, that you make the credit permanent, we are asking you not to withdraw that support. Continuation is necessary to maintain the "Stay Ahead!" climate that both Parties are calling for.

A simple extension would not serve to sustain the Credit as an incentive. Already, companies realize the possibility of imminent sunset; their apportioning of funds for ongoing R&D programs has, consequently, already become hesitant; their apportioning of more funds (since this is an incremental Credit) for future R&D programs has become downright reluctant.

Compaines in the "hi-tech" industries have to plan ahead—way ahead. Knowing that we were preparing this testimony, one company contacted EIA to emphasize that its top management has a "5-year Guide Plan." It serves to plan the apportioning of resources between divisions of the company, on the one hand, and between overhead budgets on the other hand. In the latter context, decisions are made now on how much to spend on advertising, for example, as compared to R&D—over each of the next five years.

If the Credit is going to become an On-again, Off-again proposition—every two or three years—the prospect of doing more R&D every year is diminished. We all recall that the investment tax credit was less effective during periods of suspension and re-instatement several years ago.

This has to be a sustained effort. The trade posture of American Industry vis a vis its foreign competitors is not all that good. Last year, for the first time in history, we suffered a deficit in electronic trade. $26.7 billion worth of electronic products were exported, but $27.6 billion were imported from foreign sources. There was a $900 million deficit in 1983. The previous year, there had been a $3.2 billion surplus. In other words there was $3.3 billion swing in one year—downwards!

Mr. Chairman, your Question #2 was: Does the credit operate to stimulate additional research expenditures, or simply reward research expenditures which would have been made in the absence of a credit?

Nobody is ever going to know, for sure, whether an American company would have conducted R&D at its 1981–84 magnitude if the Credit had not been there. But I am here to assure you that its existence did have a positive effect on the resource-apportioning decisions of top management. I can also assure you that more R&D is being done in the electronic industries now than in 1980 (before the Credit was enacted).

At the present time, R&D is growing more rapidly than GNP. Perhaps one cannot translate this present manifestation into future growth of the economy by economertic means, but we are dead certain that the Cause-and-Effect relationship is positive.

Your Question #3 was: Which types of research expenditures and industry activities have generated use of the tax credit?

To this, I would say that the Credit has stimulated Basic more so than Applied research.

That is not altogether praiseworthy. The downstreams rewards of research lie in the new and better products it leads to, in the jobs required to make them, in the incomes those workers earn, in the goods they can thereby afford, in the demand which that, in turn, generates for more products. But all of that hinges on applying the results of an experiment to the development of a saleable product.

It is just as important to develop a new telecommunications system as to have conducted the laboratory experiments preceding its design. Towards the end of this statement, we will address your questions #4 and #11 about possible changes in the statute. But, right here, let me observe that present regulations qualify Basic research more readily than Applied research—and it is a long way from laboratory to factory.

The Subcommittee's Question #8 was: What is the impact of the provisions on federal revenues?

The provisions have a positive impact on federal revenues. Since they also serve to reduce federal spending, their impact on the budget deficit is favorable, too.

In order to accept that, however, you must be willing to look more broadly and further ahead than the so-called "revenue-loss" method of calculating impact. My argument includes the downstream yield of R&D, and its ripple effects on the vitality of U.S. Industry.

Realizing that we were losing ground to aggressive foreign competitors—as is evidenced by the $3.3 billion swing from trade surplus to deficit in one year—the members of our Association spent a full year assessing the reasons and contemplating solutions. The results were then compiled in our Platform for Improving the Vitality of U.S. Industry.

We say:

"The world economy is changing dramatically. The United States is facing a new technological age. Our existing structure of policies, laws, and institutions has provided the environment for our economic growth to date. Does it fit the future?

"Huge investment will be required to maintain excellence in the emerging technologies. Trade, investment, and tax policies must be adapted to meet worldwide economic competition. We must discover what the skill needs of our new industries will be, and ensure that a sufficient supply of those skills exists in the work force.

"While we must reorient our policies, we should not simply emulate the practices of other nations to achieve economic success.

"Instead, management, labor, academia, the financial community, the legislative and executive branches of government must each accept their appropriate role in this extremely important task of improving the vitality of U.S. industry. Toward that objective, these are the recommendations of the U.S. electronic industries."

Those recommendations are organized into five groups: Fiscal Policy; Trade and Industrial Policy; Research and Development Policy; Human Resources Policy; and Management Improvement Policy.

Here is how the entire community of electronic companies feel about Research & Development Policy:

"Government investment in Research and Development (R&D) should continue to serve the government's own military and space objectives and the fundamental need for basic research at universities and institutions of higher learning in the fields of engineering, physics, chemistry, and biology.

"Industry's investment in R&D must be encouraged. This was affirmatively recognized in the Economic Recovery Tax Act of 1981, which created a tax credit for some R&D expenditures made by industry. It also permitted the deduction of R&D expenditures made in the U.S. from income earned in the U.S.

"However, both provisions are temporary. Industry cannot be expected to change its long-term R&D planning when the incentives are scheduled to disappear in a year or two. The 1981 tax law represents the incentive approach and should be expanded.

"Joint ventures in the conduct of R&D should be accommodated when justified and should be freed from uncertainties concerning the applicability of the antitrust laws. Very large investment is prerequisite to the undertaking of complex, advanced R&D projects. Joint ventures serve to spread the cost and share the risk of such projects; they preclude wasteful duplication of effort among the cooperating companies; they should be encouraged."

Your Question #4 was: Should the categories of qualifying research expenditures be broadened or narrowed?

Broaden the category which qualified Applied research—as I explained earlier in this statement.

Broaden the statute so as to qualify "Software" that is clearly used in the processes of today's research and experimentation.

Narrow the definition of "Customer-funded" research which does NOT qualify for the Credit. Please understand that all R&D is done with expectancy of recovering its cost by selling resultant products, that customers thereby fund R&D, and that customers are some in the private sector and others in the public sector.

Your Question #11 was: Should any statutory or administrative changes be made in the event the credit is continued?

I consider that we have just indicated statutory changes deserving your sincere consideration.

But, frankly, I am not here today to discuss technicalities or tinkering. On those there are, in any event, differing schools of thought. I am here today to say one thing: Make the Credit permanent!

Mr. PICKLE. Well, sir, I had asked the panel earlier to respond to the particular question of whether the research each of you may carry on was related to basic research, improvement of an existing product, or development of a new product.

Most specifically now, let me ask you if the electronics industry would support a requirement that firms claiming the credit provide to the Internal Revenue Service this information: The specific type of R&D activity involved, using a code name so that your particular work could be classified; whether you expect the product to ultimately be produced or improved, or whether or not you are just toying with something, whether the R&D relates to improvement of an existing product or the development of a new product; and whether the product involved would be manufactured or used by the researcher.

I would like to have those kind of answers either now or in general, or in writing to us.

Do you have any objection to giving IRS or us this type of information?

Would you support that?

Mr. McCLOSKEY. Well, if you mean that a company taking the credit ought to file statements as to each of the projects that generated the credit, then you will have required some major recordkeeping.

I think, however, that companies might be called upon to answer specific questions of that nature during the audit phase. I, for one, am not in favor of limiting the research and development credit to basic research. I, for one, feel that direct subsidy to companies, as had earlier been proposed as an alternative, is not at all desirable. You have got the best of both worlds by providing, in the tax credit mechanism, some concept of matching funds—but one wherein the overwhelming portion of those funds must come from the companies. They are in the best position to determine how much should be spent on which R&D projects.

Even in the area of style changes in the automotive industry, since that question did arise today, it is important for those companies to be competitive. They are not just competing against their own U.S. counterparts; they are competing in an international market here in the United States. Part of that competitiveness is advanced styling techniques. Although some might be just cosmetic, a large measure of design change does serve to improve fuel efficiency, and so forth, I do not know that one should make judgments as to whether a given project is less desirable or more desirable because it falls into basic or into applied research. I think we ought to rest assured that the companies making this or that investment in research and development are doing it to make their products more competitive, and that is the real, ultimate bottom line.

Mr. PICKLE. Well, Mr. McCloskey, I was not here earlier this morning, but I understand that Treasury in its testimony—and were you here?

Mr. McCLOSKEY. I heard part of that, sir.

Mr. PICKLE. Indicated it was very difficult to know how to answer specifically whether you should make the credit permanent, or in what amount because they were trying to study the figures that they have. They apparently have difficulty getting from you or from other companies exactly what you have used your R&D for.

Now, you have said yes, you would be glad to give IRS figures on an audit. I am asking you, though, and you haven't answered my question, would you give this information to the Internal Revenue Service for purposes of trying to ascertain what has happened with this credit and to use that as a base to know what we would do in the future?

Mr. **McCloskey**. Well, we have over 1,000 companies, so it becomes a massive job. If our association were asked to do a survey of a reasonable sample of our member companies, and if it aimed at ascertaining their present practices, and if we could agree on the categories to be repeated, then I would be very amenable to attempting it. We might work with your staff to determine which categories you would like to see.

Mr. **Pickle**. I do not know that I am in a position to say that I would be satisfied about a survey or a cross section. I do not see any reason why any one of you, if you are claiming a 25-percent credit, cannot say exactly where you have claimed it and in what area and in what amount. Why do you have to be so coy about it?

Mr. **McCloskey**. Because we are a trade association that represents a number of manufacturers, and we do not have that data. Individual companies have the data.

Mr. **Pickle**. Well, we cannot really make a determination unless we have some figures that we can back it up with.

Do any of you disagree that this information should not be given to either us or the Internal Revenue Service?

Mr. **Vander Veen**. Mr. Pickle, I am Richard Vander Veen. I am from Lansing, MI, and I represent Lear Siegler, and certainly our company Lear Siegler has operations in Texas and does research there, and we are delighted to show you what we do and how we spend the money.

Mr. **Pickle**. Well, I would think that you would, and I would think that you would intend to. We are for this credit, but we have got to establish the facts.

Mr. **McCloskey**. I think individual companies would be willing to share.

Mr. **Pickle**. Mr. Vander Veen, I notice you are on the list, Richard Vander Veen. It seems to me like we had a Member of Congress named Vander Veen.

Mr. **Vander Veen**. Yes; that was my father, and he sends his regards from Grand Rapids.

Mr. **Pickle**. He was a grand man. I wish he had been from Texas. [General laughter.]

Well, aside from that, give him my regards because he is a fine gentleman.

Well, Mr. McCloskey, to what extent have your association members contracted for basic research work to be done by the universities? Do you know?

Mr. **McCloskey**. I think it has been very significant in the electronics community.

Mr. **Pickle**. I would think so, and if you have not, try to do a little more. And I am not arguing with you. I am just saying that if this committee is interested in trying to advance this program, we must have some good, reliable information, and our Department down the street, the Treasury, must be satisfied that these are the facts, and it is working this way.

I do not think any of you companies should be reticent to give us information. If it is a good program, then let's be forthright and give us the information we need.

Mr. McCLOSKEY. Might I amplify the point about the research and development? I think research and development performed in the United States has a ripple effect through our society. It does include the utilization of universities. It also includes those universities' graduates that go out into companies and are productive right away, as Mr. Shannon indicated. It also includes the spinoff of high tech companies that occurs around universities. Take Austin, TX, and around Stanford University, and around MIT. At each place, you see a plethora of companies that developed in just that way.

And if we allow the research and development to go offshore—because we withhold incentives and do not recognize that they exist offshore—we are at risk, and I think it is wrong.

Mr. PICKLE. We do not disagree with that.

Electronic Industries Association

Peter F. McCloskey
President

January 16, 1985

RECEIVED
JAN 24
Ways and Means
Subcommittee on Oversight

The Honorable Charles B. Rangel
Chairman, Subcommittee on Oversight
Committee on Ways and Means
1101 Longworth House Office Building
U.S. House of Representatives
Washington, D. C. 20515

re: Utilization of the Research
and Experimentation Tax Credit.

Dear Chairman Rangel:

Subsequent to my testimony last August recommending extension of this Credit, you sent me a Questionnaire. In subsequent discussions with Oversight Subcommittee staff, it was agreed that our Association would conduct a survey among its member companies, seeking their individual response to your questions; that we would assemble those received and forward them to you before the 99th Congress convenes.

Now enclosed are 13 individual responses; these contain substantive information of the type you seek. It was also agreed with Oversight Subcommittee staff that a responding company need not reveal its identity. Of the 13 enclosures, five companies requested that they not be identified.

Another company responded that it has not, itself, utilized the Credit but went on to comment as follows:

> "This company is much too small to do pure research or to fund any formal experimentation with universities or other non-profit organizations. (We do occasionally make a modest contribution of time or money to a research project and have, on a few occasions, taken a license on a development from a non-profit research laboratory.)
>
> "Primarily we depend upon our suppliers of materials and equipment for techniques and ideas, and more often upon the requirements specified by our customers or potential customers, often as a result of their research and development efforts. The investment tax credit for R&D is significant to all those categories and therefore of importance to us.

2001 Eye Street, N.W. · Washington, D. C. 20006 · (202) 457-4900 · TWX: 710-822-0148

> "We never have had much success with any sort of incremental tax credits since the late 1950's. The regulations never seem to quite cover our situation on each and every point of qualification. We do strongly favor extension of the research and experimentation tax credit as a matter of national policy, but would not like to see the addition of more restrictions. (If it gets more complicated, the emphasis will be akin to writing a grants-proposal instead of searching for new concepts and techniques and designs.)
>
> "We also do not feet that all research and experimentation needs to be done by people in white coats in white rooms. Rather, it is our opinion that anything which will produce new or more efficient economic activity in any legal industry should be acceptable. Even in electronics some of the best ideas have come from people in jeans working in the garage."

Chairman Rangel, you and members of your Subcommittee may contact me whenever questions arise on this Credit. A fiscal incentive for American companies to take the risks entailed in launching research and development projects -- which might or might not yield fruitful result -- is no less than imperative. Against the so-called "revenue loss" attributable to the Credit, as such, please weigh the value of generating more industrial activity and employment -- both of which raise revenue.

Sincerely yours,

Peter McCloskey

Peter F. McCloskey
President

Enclosures
PFM:ahg

cc: The Honorable J. J. Pickle
Ms. Beth Kuntz

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

X Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and **(CHECK ONE)**

  X **EIA may identify our company when forwarding our response to the Ways and Means Committee.**

  ____ **EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.**

RESPONDENT'S NAME: JAMES A. TAYLOR

RESPONDENT'S PHONE NUMBER: (415) 424-5310

YOUR COMPANY: VARIAN ASSOCIATES, INC.

Varian / 611 Hansen Way / P.O. Box 10800 / Palo Alto / California 94303-0883 U.S.A.
Tel. (415) 493-4000
Telex 348476

varian

January 7, 1985

Mr. Peter F. McCloskey, President
Electronics Industry Association (EIA)
2001 Eye Street, N.W.
Washington, D.C. 20006

Re: EIA 1984 Survey on R&D Tax Credit

Dear Mr. McCloskey:

As requested in your November 30th letter, attached is Varian's completed response to the 1984 Questionnaire on the R&D tax credit. I apologize for the delay in response but, unfortunately, the questionnaire was routed through a number of people before it was received by the Corporate Tax Department who can respond to such matters. Hopefully, you will still be able to utilize the information since the R&D tax credit is very important to us and I believe other EIA members.

In the future, please note Varian could provide a much more expeditious response to questions on tax matters if the inquiry or survey was initially directed to my attention in the Corporate Tax Department at 611 Hansen Way, E-029, Palo Alto, California, 94303.

We are very active in trying to lobby for the permanent extension of the R&D tax credit legislation, both as a company and through other industry groups. Therefore, we appreciate any assistance which EIA can provide on the extension and I would be pleased to discuss this matter with you or your staff at any convenient time.

Very truly yours,

VARIAN ASSOCIATES, INC.

James A. Taylor
Director of Taxes

dm
Attachment

cc: M. Redmond
G. Simpson

ELECTRONIC INDUSTRIES ASSOCIATION

1984 QUESTIONNAIRE ON THE R&D TAX CREDIT

1. For which years has your company claimed The Credit?

   - FY 1981, 1982, 1983 and 1984.

   a. What was the amount of credit claimed for each of those years?

- FY 1981	$ 69K
1982	819K
1983	3,542K
1984 (est.)	4,300K

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic Research

Basic Research	- FY 1981	1.2%
	1982	0.0
	1983	0.4
	1984	0.1

   b. Applied Research (Further breakdown unavailable) -

- FY 1981	98.8%
1982	100.0
1983	99.6
1984	99.9

3. Did the research activities in 2., above, pertain to:

   2 Raw materials for use in electronic products?
   1 Component parts (or sub-assemblies) of electronic equipment?
   3 Electronic equipment?
   4 "Systems" linking several pieces of electronic equipment?
   5 A process for manufacturing, assemblying, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   3 Consumer end-uses?
   1 Industrial (or Commercial) end-uses?
   2 Military (or Defense) end-uses?

5. From the field of projects that figured in your responses to questions 1. through 4. above, please describe at least one

specific project or experimental activity that your company might NOT have undertaken if The Credit had not been available.

a. Developing an analytical instrument which utilizes nuclear magnetic resonance techniques to diagnose chemical/medical conditions within the human body through unique "scanning" techniques. This research project would not have been undertaken at this time had The Credit not been available since The Credit allowed the project to meet a certain minimum financial "threshold" level for such projects.

b. Developing a hypothermia technique by which cancerous cells will be heated and destroyed without damaging surrounding tissue. Again, this research project would not have been undertaken at this time had The Credit not been available to provide the extra financial stimulus to push this project over internal financial threshold levels.

6. If The Credit had not been available, would your company likely have. . .

_X_ deferred to the future
_X_ never undertaken

the project(s) or experimental activity(ies) defined in your response to question 5?

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED?

This information is not readily available. Since the company undertakes hundreds of research projects each year the elimination of these two projects would not have had a significant impact on the Company's R&D spending. However, elimination of The Credit would have reduced R&D spending for many other projects and could, therefore, have had a negative impact on R&D spending in total. Note: R&D spending increased 94% from FY 1981 through FY 1984 and it increased from 6.0% to 7.1% of sales during this same period. The Credit significantly contributed to these increases.

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your Company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?

No.

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and-budgeting?

This would allow the company to continue the trend described in response to 7. of significantly increasing in R&D spending which is now starting to slow partly due to uncertainties about The Credit. There is marked pressure to increase research spending at our oversea's manufacturing facilities which has not been implemented in the past due to the availability of The Credit on research conducted in the U.S. A permanent extension of The Credit would continue to make it more advantageous to conduct most such research in the U.S. which would not be the case if The Credit is allowed to expire.

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.) but to exclude expenditures for Applied research (question 2.b.), how would that affect your company's long-term research-planning and-budgeting?

As indicated, in response to question 2, far less than 1% of the company's research funds are expended on Basic research. Thus, if The Credit only applied to Basic research activities it would totally loose its impact on our company's R&D spending decisions. It is believed this would have the effects of (1) deferring both spending on certain existing projects and deferring the start date of some new projects, (2) eliminating some research projects from being undertaken at all, and (3) shifting some of the company's R&D activities overseas where the local tax and other financial incentives would then make conducting R&D activities much more attractive than in the U.S. (specific examples would be Japan and Canada).

Tom [illegible]

DEC 26 1984

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

_X_ Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and **(CHECK ONE)**

  _X_ EIA may identify our company when forwarding our response to the Ways and Means Committee.

  ____ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

RESPONDENT'S NAME: M. C. Howell

RESPONDENT'S PHONE NUMBER: (703) 356-0480

YOUR COMPANY: Dynalectron Corporation

12/20/84

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit? 1981, 1982

   a. What was the amount of Credit claimed in each of those years?
   $31,249, 48,113 RESPECTIVELY

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research? 20%

   b. Applied research: 80%

      1. Development of a new product?

      2. Improvement of an existing product?

      RESEARCH DOES NOT APPLY TO A PRODUCT (TANGIBLE). MORE TO PROPRIETARY PROCESSES IN THE PETROCHEMICAL INDUSTRY.

3. Did the research activities in 2., above, pertain to:

   • Indicate order of importance; "1" as the most important.

   ____ Raw materials for use in electronic products?

   ____ Component parts (or sub-assemblies) of electronic equipment?

   ____ Electronic equipment?

   ____ "Systems" linking several pieces of electronic equipment?

   X A process for ~~manufacturing, assembling, or testing one of the above?~~ THE DEVELOPMENT/IMPROVEMENT TO PETROCHEMICAL/REFINING INDUSTRY RELATING TO CRUDE STOCKS

4. To which end-uses are the products or processes in 3., above, destined:

   • Indicate order of importance; "1" as the most important.

   X Consumer end-use?

   X Industrial (or Commercial) end-use?

   X Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. PROJECTS ARE ONGOING AS THE NATURE OF BUSINESS CREATING THE CREDIT AND WILL CONTINUE REGARDLESS.
   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other**

   ....deferred to the future

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5. SEE ANSWER TO NO. 5

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED?

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)? SOME SOFTWARE DEVELOPMENT COSTS.

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? NONE OTHER THAN NORMAL.

10. If 1985 legislation were to **include** expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? NONE

EIA 1984 Survey QUESTIONNAIRE

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

XX Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and **(CHECK ONE)**

  XX EIA may identify our company when forwarding our response to the Ways and Means Committee.

  ____ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

RESPONDENT'S NAME: Lester D. Ezrati

RESPONDENT'S PHONE NUMBER: 415-857-2089

YOUR COMPANY: Hewlett-Packard Company

1. Hewlett-Packard Company ("HP") claimed the Credit as follows:

Year Ended October 31	Amount $ Millions
1981	6
1982	16
1983	25
1984	26

5. If the Credit had not been available, HP might not have undertaken basic research in the area of raw materials for electronic products destined for commercial end use.

DEC 21 1984

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit? See attached sheet.

   a. What was the amount of Credit claimed in each of those years?

2. What percentage of the amounts in 1., above, was expended on: This information is not available from current accounting records.

   a. Basic (pure) research?

   b. Applied research:

      1. Development of a new product?

      2. Improvement of an existing product?

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   _2_ Raw materials for use in electronic products?

   _3_ Component parts (or sub-assemblies) of electronic equipment?

   _1_ Electronic equipment?

   _4_ "Systems" linking several pieces of electronic equipment?

   _5_ A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   _2_ Consumer end-use?

   _1_ Industrial (or Commercial) end-use?

   _3_ Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. See attached sheet.

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other**

   ....deferred to the future XX

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? Unknown

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?
   Yes, approximately .01%

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting?
   It would afford greater certainty.

10. If 1985 legislation were to **include** expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? Unchanged

EIA 1984 Survey QUESTIONNAIRE

Tom [illegible]

DEC 20 1984

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

✓ Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and **(CHECK ONE)**

- ✓ EIA may identify our company when forwarding our response to the Ways and Means Committee.
- ____ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

RESPONDENT'S NAME: Robert W. Scott

RESPONDENT'S PHONE NUMBER: (219) 293-7511

YOUR COMPANY: CTS Corporation

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit?

   a. What was the amount of Credit claimed in each of those years?
   1981 - $135,943   1982 - $177,112   1983 - $159,106

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research? 10%

   b. Applied research: 90%

      1. Development of a new product? 90%

      2. Improvement of an existing product? 10%

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   1 Raw materials for use in electronic products?

   2 Component parts (or sub-assemblies) of electronic equipment?

   5 Electronic equipment?

   4 "Systems" linking several pieces of electronic equipment?

   3 A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   2 Consumer end-use?

   1 Industrial (or Commercial) end-use?

   3 Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. Investigation of TIN as a replacement for Gold on dry circuit switching

- Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

Basic Research - Industrial + Consumer + [illegible] Military

6. If The Credit had not been available, would your company likely have...

• Indicate one or the other

....deferred to the future

[✓ ....never undertaken]

the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? not yet determined

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)? no

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? We would have a larger budget for R+D

10. If 1985 legislation were to **include** expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? Negatively - there would be less R+D budgeted in the future.

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

_X_ Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and **(CHECK ONE)** Will claim this year WE ARE NEW START-UP.

- _V_ EIA may identify our company when forwarding our response to the Ways and Means Committee.
- ____ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

RESPONDENT'S NAME: KEN VOIGHT

RESPONDENT'S PHONE NUMBER: 1-800-223-4637

YOUR COMPANY: Promax Electronics Corp.

PEC PROMAX

KEN VOIGHT
VICE PRESIDENT

PROMAX ELECTRONICS CORPORATION, U.S.A.
10556 Bechler River Avenue
Fountain Valley, California 92708
714-964-0609 TELEX 4994648 KENOA

TOM PATTON

DEC 10 [illegible]

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the R&D Tax Credit ("The Credit")

1. For which years has your company claimed The Credit?
   a. What was the amount of Credit claimed in each of those years?
2. What percentage of the amounts in 1., above, was expended on:
   a. Basic (pure) research?
   b. Applied research:
      1. Development of a new product?
      2. Improvement of an existing product?
3. Did the research activities in 2., above, pertain to:
   - **Indicate order of importance; "1" as the most important.**

     2 Raw materials for use in electronic products?

     1 Component parts (or sub-assemblies) of electronic equipment?

     4 Electronic equipment?

     5 "Systems" linking several pieces of electronic equipment?

     3 A process for manufacturing, assembling, or testing one of the above?
4. To which end-uses are the products or processes in 3., above, destined:
   - **Indicate order of importance; "1" as the most important.**

     3 Consumer end-use?

     1 Industrial (or Commercial) end-use?

     2 Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available.

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

   INVESTMENT OF $300,000 INTO AUTOMATING PRODUCTION RESEARCH & DEVELOPMENT FOR DIODES,

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other**

   ....deferred to the future

   [✓ ....never undertaken]

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED?

N/A 8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? UNKOWN

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? UNKNOWN

EIA 1984 Survey QUESTIONNAIRE

DEC 10 1984

TOM PATTON

T&B

THOMAS & BETTS
CORPORATION

920 Route 202
Raritan, New Jersey 08869
201-685-1600
Telex 833190

December 6, 1984

Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N.W.
Washington, D.C. 20006

Dear Mr. McCloskey:

Enclosed is the completed 1984 Survey as you requested.

Very truly yours,

THOMAS & BETTS CORPORATION

Joanna W Kahlbrock

Joanna W. Kahlbrock
Corporate Director of Tax Compliance

ac

Enclosure

CHECK ONE

___ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

_X_ Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and (CHECK ONE)

- _X_ EIA may identify our company when forwarding our response to the Ways and Means Committee.
- ___ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

Please attach your answers to these questions to the Response Transmittal Form provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the R&D Tax Credit ("The Credit")

1. For which years has your company claimed The Credit? 1981-$ 69,120

   a. What was the amount of Credit claimed in each of those years? 1982-$ 106,984 1983-$ 136,403

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research? NONE

   b. Applied research:

      1. Development of a new product? 50%

      2. Improvement of an existing product? 50%

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   4 Raw materials for use in electronic products?

   1 Component parts (or sub-assemblies) of electronic equipment?

   5 Electronic equipment?

   2 "Systems" linking several pieces of electronic equipment?

   3 A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   2 Consumer end-use?

   1 Industrial (or Commercial) end-use?

   3 Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe at least one specific project or experimental activity that your company might NOT have undertaken if The Credit had not been available. NONE

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - Indicate one or the other

   ....deferred to the future NEITHER

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? N/A

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?
   See Attached

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting?
   No real significant change

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.)...but to exclude expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting?
    See Attached

8. Yes, the expenses classified as Research & Development for financial statement purposes are reported to the SEC while the expenses used in the determination of the Research & Development credit include only those incurred for applied research of new products and improvement of existing products plus computer programming (software) developed in-house.

10. Since the R&D Credit is looked upon as a little bit of icing the only effect on this company's long term research planning would be to have a little more spent on developing new products.

Tom Patton

DEC 1 2 1984

GEORGE R. MOSES
1341 G St., Suite 202, Washington, D.C. 20005 (202) 628-1980

December 11, 1984

Mr. Peter F. McCloskey
President
Electronic Industries Association
2001 Eye Street, N.W.
Washington, D.C. 20006

Dear Pete:

I am attaching to the EIA questionnaire the response M/A-COM has already provided to the Ways and Means Subcommittee chaired by Congressman Rangel. If this information is not sufficient, please let me know and I will attempt to obtain further data as required.

Very sincerely,

George

George R. Moses

MCI ID: 194-5155 TWX: 6501945155

M/A-COM

M/A-COM, INC.
1350 PICCARD DRIVE
ROCKVILLE, MD 20850
(301) 258-8940
TWX 710-828-9792

December 7, 1984
CA-587-84

Hon. Charles B. Rangel, Chairman
Oversight Subcommittee
Ways and Means Committee
U.S. House of Representatives
Washington, DC 20515

Dear Chairman Rangel:

We are submitting the response to your request for additional information on R&D spending. We apologize for the delay in submitting this information. Please accept the following supplemental information for the record of the August 3 hearings on the research and experimentation tax credit.

Question 1:

M/A-COM claimed the tax credit for the following amounts for the years shown:

1981	$0.2 million
1982	$1.6 million
1983	$3.5 million.

However, we are currently restudying our internal data and we plan to submit a revised return in the near future. The revised amounts should be of the same order of magnitude as those shown above.

Questions 2 and 3:

See the attached table for descriptions of the largest research programs for which the credit was claimed.

Question 4:

It is impossible to say with any certainty how our R&D would have been affected if the credit had not been available. Most likely, none of the projects in the attached table would have been cancelled since these are the largest projects. However, the amount of funding may well have been reduced, resulting in a longer time for development. Some smaller research tasks, in these or other activities, might have been cancelled. However, M/A-COM's R&D decisionmaking is not precise enough to provide the detail requested.

Hon. Charles B. Rangel
December 7, 1984
Page 2

Question 5:

No research and experimentation was undertaken primarily because of the tax credit.

Question 6:

Many of the expenditures reported as qualified expenditures in claiming the credit were not reported as research costs to the SEC, but rather were included in Cost of Goods Sold for financial reporting purposes. It is very difficult, at best, to break down the costs between those reported as research costs to the SEC and those reported as part of Cost of Goods Sold.

Question 7:

If the credit is made permanent, M/A-COM's long-term research budgeting will be a more stable process than today. We have begun certain high-risk projects with the assumption that the credit would be extended. At this point in time, having seen the failure of the 1984 effort to extend the credit, we are less likely to start new high-risk research programs. Just like any other business uncertainty, the uncertainty in the future of the tax credit is having a negative impact on our planning.

Question 8:

If development expenditures were to be excluded from the tax credit, a large part of our R&D expenditures would no longer be qualified for the credit. The impact would be virtually the same as allowing the credit to expire. It would no longer be of much use to America's high-tech industry, and would no longer affect the attitudes of company management in the same way that the credit currently does.

I hope that these answers have been responsive to your needs and that this information will be helpful as you consider the extension of the tax credit.

Sincerely,

Jeffrey Krauss

Jeffrey A. Krauss
Vice President
Corporate Affairs
M/A-COM Development Corporation

JAK/pk

M/A-COM

bcc: [redacted]
J. Saloom
S. Zezima

Summary of Some Major M/A-COM R&D Activities

Specific type of research	Basic research, product improvement, or new product	Type of improvement or product
electronics	new product	development of new fiber optic communications system for local distribution
electronics, firmware, software	new product	development of shore-based satellite earth station for maritime communications
electronics, firmware, software	product improvement	development of new signal interpolation techniques that increase the capacity of digital satellite earth stations
electronics, firmware, software	new product	development of electronics to aggregate the digital signals transmitted through a satellite and process them to permit more intensive use of the satellite frequency spectrum
electronics, firmware, software	new product	development of video encryption system for use with satellite-distributed signals
materials research	basic research, new product	development of techniques for producing GaAs materials, components and integrated subsystems

M/A-COM

DEC 2 6 1984

Tom P

RESPONSE TRANSMITTAL FORM

Please attach this form to your response to the Questionnaire and mail them BY FRIDAY, DECEMBER 21...

TO: Peter F. McCloskey, President
Electronic Industries Association (EIA)
2001 Eye Street, N. W.
Washington, D. C. 20006

re: EIA 1984 Survey
on R&D Tax Credit

CHECK ONE

____ Our company has NOT claimed the R&D Tax Credit, so we will not be returning a Questionnaire.

_X_ Our company HAS claimed the R&D Tax Credit, so I am attaching our response to the Questionnaire...and (CHECK ONE)

- ____ EIA may identify our company when forwarding our response to the Ways and Means Committee.
- ____ EIA may NOT identify our company when forwarding our response to the Ways and Means Committee.

Their response form clearly identifies Motorola... and the text of several answers clearly reflects their intent to allow Motorola to be identified.
1-10

RESPONDENT'S NAME:	H. Richard Klotz
RESPONDENT'S PHONE NUMBER:	(312) 576-5020
YOUR COMPANY:	Motorola, Inc.

EIA 1984
QUESTIONNAIRE
on the R&D Tax Credit ("The Credit")

1. For which years has your company claimed The Credit?

   A. Motorola claimed the following credits:

Year	Credit Claimed
1981	$ 6.54 mil.
1982	10.78 mil.
1983	16.64 mil.

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research?

   b. Applied research:

      1) Development of a new product?

      2) Improvement of an existing product?

   A. This question cannot be answered specifically as the majority of our R&D expenditures are fungible and of a continuous nature. The fact is, our expenditures increased in 1981, the first year of the credit, to 5.6% of sales from 3.9% of sales in 1980. We continued to spend at that accelerated pace in 1982 and 1983. We attribute this significant increase directly to an awareness by our operating and research personnel of the tax benefit available through the credit.

3. Did the research activities in 2., above, pertain to:

   - Indicate order of importance; "1" as the most important.

   _1_ Raw materials for use in electronic products?
   _1_ Component parts (or sub-assemblies) of electronic equipment?
   _2_ Electronic equipment?
   _3_ "Systems" linking several pieces of electronic equipment?
   _4_ A process for manufacturing, assembling, or testing one of the above?

HRK:12/21/84

QUESTIONNAIRE (page 2 of 3)

4. To which end-users are the products or processes in 3., above, destined:

   - Indicate order of importance; "1" as the most important.

   _3_ Consumer end-use?
   _1_ Industrial (or Commercial) end-use?
   _2_ Military (or Defense) end-use?

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe at least one specific project or experimental activity that your company might NOT have undertaken if The Credit had not been available.

   A. As indicated in the response to question 2, it is not possible to identify a specific project undertaken as a result of The Credit. However, the increase in our R&D as a percent of sales in 1981 is a significant indication of our total commitment to the utilization of the Credit.

6. If The Credit had not been available, would your company likely have...

   - Indicate one or the other

   ____ deferred to the future

   ____ never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

   A. Answers to questions 2 and 5 respond to this question.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED?

   A. This is almost impossible to quantify but if the percentage to sales had remained about the same as in 1980, the reduction would have been:

1981	$ 59.6 mil.
1982	58.7 mil.
1983	75.3 mil.

HRK:12/21/84

QUESTIONNAIRE (Page 3 of 3)

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?

   A. Almost without exception, the expenditures claimed for the tax credit are included in the research expenditures reported to the SEC. The amounts reported to the SEC in fact exceed the amounts used for tax credit purposes, primarily due to depreciation on R&E equipment (non-includable for tax credit purposes).

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting?

   A. As stated to the Subcommittee House Ways and Means Oversight by our Executive Vice President representing EIA at hearings held earlier this year, most of our research and development involves time periods exceeding one year and in the case of the cellular radiotelephone equipment, development took place over ten years. If in fact the credit is to act as an incentive to R&D efforts, then it must be perceived as "long-term" and allow companies to make it a part of their long-term strategic product development budgets.

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.)...but to exclude expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting?

   A. We do not presently keep records to segregate expenditures in these two categories since we feel they are so interrelated to the final finished product. Should we be required to do so, many "guesstimates" would have to be made but in the final analysis we would have to continue spending our research dollars as we do today if we are to remain competitive in the electronic businesses currently in our product portfolio.

HRK:12/21/84

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed the Credit?

RESPONSE: 1981, 1982, 1983, and 1984

a. What was the amount of Credit claimed in each of those years?

RESPONSE:

	1981	$ 506,000	1983	$4,560,000
	1982	$4,427,000	1984	$4,500,000 Estimate

2. What percentage of the amounts in 1., above, was expended on:

a. Basic (pure) research?

RESPONSE: We estimate the following:

1981	10%*	1983	10%*
1982	10%*	1984	10%*

b. Applied research:

1. Development of a new product?

RESPONSE: We estimate the following:

1981	80%*	1983	80%*
1982	80%*	1984	80%*

2. Improvement of an existing product?

RESPONSE: We estimate the following:

1981	10%*	1983	10%*
1982	10%*	1984	10%*

*These estimates are currently being refined.

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   5 Raw materials for use in electronic products?

   3 Component parts (or sub-assemblies) of electronic equipment?

   1 Electronic equipment?

   2 "Systems" linking several pieces of electronic equipment?

   4 A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   3 Consumer end-use?

   1 Industrial (or Commercial) end-use?

   2 Military (or Defense) end-use?

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if the Credit had not been available.

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

3 of 4

RESPONSE:

Example #1: Develop a set of features on a commercial voice/data product (switch) that are specific to the needs of U.S. military installations in North America and at overseas bases.

This item would come under the classification of:

- o 2; 2(b) applied research
- o 3; Electronic equipment
- o 4; Military end-use

Example #2: Develop a set of features and interface standards on a North American voice/data product (switch) that are required in other countries to obtain export sales.

This item would come under the classification of:

- o 2; 2(b) applied research
- o 3; Electronic equipment
- o 4; Consumer end-use

6. If the Credit had not been available, would your company likely have...

o Indicate one or the other

.....deferred to the future

.....never undertaken

the project(s) or experimental activity(ies) defined in your response to quesiton 5.

RESPONSE: Never Undertaken or strongly considered undertaking the activities in a country which provides tax incentives for R&D expenditures.

4 of 4

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a have been REDUCED?

   RESPONSE: We estimate that the expenditures would have been reduced by approximately the amount of the credit.

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?

   RESPONSE: No

9. If the Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting?

   RESPONSE: We expect that there would be a direct relationship between the R&D Credit claimed and amount of monies allocated for, and incurred in, U.S. Research and Development expeditures.

10. If 1985 legislation were to **include** expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b)...how would that affect your company's long-term research-planning and -budgeting?

    RESPONSE: We expect that there would be a direct relationship between the R&D Credit claimed and amount of monies allocated for, and incurred in, U.S. Research and Development expenditures.

Tom Patton DEC 28 1984

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit? 1981, 1982, 1983, [illegible]

   a. What was the amount of Credit claimed in each of those years?
   1981 - $12,559 ; 1982 - $988 ; 1983 - 40,517 ; 1984 - 12,000 est.

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research? -0-

   b. Applied research:

      1. Development of a new product? 80 %

      2. Improvement of an existing product? 20 %

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   ___ Raw materials for use in electronic products?

   _1_ Component parts (or sub-assemblies) of electronic equipment?

   ___ Electronic equipment?

   ___ "Systems" linking several pieces of electronic equipment?

   _1_ A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   ___ Consumer end-use?

   _1_ Industrial (or Commercial) end-use?

   _1_ Military (or Defense) end-use?

Both very close to # 1

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe at least one specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. Developement of A New High Frequency Device Currently Now Available in The World Market. Initial Application will Be Military And Telecommunication
   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other**

   [✓ ....deferred to the future]

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? 1983 50%
1984 100%

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)? —

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? The Amount of The Credit will Be used as An Increase of Available Funds

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.)...but to exclude expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting?

EIA 1984 Survey QUESTIONNAIRE

EIA 1984
Responses to Questions on the R&D Tax Credit

1. For which years has your company claimed the credit?

    o Fiscal year ending September 30, 1983.

        a. What was the amount of credit claimed in each of these years?

    o The amount of credit claimed was $1,758,593.

2. What percentage of the amounts in 1., above was expended on?

a.	Basic research	0%
b.	Applied research	30%
c.	Development	
	1. Development of a new product	45%
	2. Improvement of an existing product	25%

o The above percentages represent the distribution of total R&D rather than only the R&D expenditures eligible for the credit.

3. Did the research activities in 2., above pertain to:

o Indicate order of importance; "1" as the most important.

____ Raw materials for use in electronic products?

3 Component parts (or sub-assemblies) of electronic equipment?

2 Electronic equipment?

1 "Systems" linking several pieces of electronic equipment?

4 A process for manufacturing, assembling or testing one of the above.

The above answer pertains only to the Electronics Operations of this company.

4. To which end users are the products or processes in 3., above destined?

Indicate order of importance: "1" as the most important

____ Consumer end use?

2 Industrial (or Commercial) end use?

1 Military (or Defense end use?

5. From the field of projects that figured in your responses to questions 1 through 4 above, please describe at least one specific project or experimental activity that your company might NOT have undertaken if the Credit had not been available.

   o All of the projects would have been undertaken even if the Credit would not have been available.

6. If the Credit had not been available, would your Company likely have ...

   o Indicate one or the other

   _____ deferred to the future

   _____ never undertaken

   The project(s) or experimental activity(ies) defined in your response to question 5.

   o Not applicable - See question 5

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED?

   o Not applicable

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed the Credit but that you company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)?

   o No.

9. If the Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research planning and budgeting?

   Making the Credit permanent would not affect this company's research planning. The IRS's proposed regulations which must be followed in determining the R&D tax credit specifically excluded the IR&D expenditures that are allocated to government cost-type and fixed price incentive type contracts. As a result of this provision, we do not derive a substantial tax benefit from the R&D tax credit. Consequently, the credit does not influence decisions on whether to increase or decrease R&D expenditures.

10. If 1985 legislation were to include expenditures for basic (pure) research (question 2.a.) but to exclude expenditures for Applied Research (question 2.b.) how would that affect your company's long-term research-planning and budgeting?

   o Such legislation would provide no benefit to this company.

Please attach your answers to the Response Transmittal Form provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit?

   a. What was the amount of Credit claimed in each of those years?

1980	403,740
1981	38,875
1982	0
1983	97,334

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research?

   b. Applied research:

      1. Development of a new product?

      2. Improvement of an existing product? ALL

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   5 Raw materials for use in electronic products?

   4 Component parts (or sub-assemblies) of electronic equipment?

   1 Electronic equipment?

   2 "Systems" linking several pieces of electronic equipment?

   3 A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   3 Consumer end-use?

   1 Industrial (or Commercial) end-use?

   2 Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe **at least one** specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. NoNE

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other** N/A

   ....deferred to the future

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? N/A

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)? No

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? NoNE

10. If 1985 legislation were to **include** expenditures for Basic (pure) research (question 2.a.)...but to **exclude** expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? NO EFFECT

Please attach your answers
to these questions to the
Response Transmittal Form
provided in this mailing.

EIA 1984
QUESTIONNAIRE
on the **R&D Tax Credit** ("The Credit")

1. For which years has your company claimed The Credit?

   a. What was the amount of Credit claimed in each of those years?

1981	$ 960,000
1982	3,000,000
1983	7,000,000

2. What percentage of the amounts in 1., above, was expended on:

   a. Basic (pure) research? 27%

   b. Applied research:

      1. Development of a new product? 6%

      2. Improvement of an existing product? 67%

3. Did the research activities in 2., above, pertain to:

   - **Indicate order of importance; "1" as the most important.**

   5 Raw materials for use in electronic products?

   3 Component parts (or sub-assemblies) of electronic equipment?

   2 Electronic equipment?

   1 "Systems" linking several pieces of electronic equipment?

   4 A process for manufacturing, assembling, or testing one of the above?

4. To which end-uses are the products or processes in 3., above, destined:

   - **Indicate order of importance; "1" as the most important.**

   3 Consumer end-use?

   2 Industrial (or Commercial) end-use?

   1 Military (or Defense) end-use?

QUESTIONNAIRE (page 2 of 2)

5. From the field of projects that figured in your responses to questions 1-through-4, above, please describe at least one specific project or experimental activity that your company **might NOT have undertaken** if The Credit had not been available. Not Available

   - Please define it/them at least in terms of the descriptors shown in questions 2, 3, and 4. For example, define a project as having related to the development of a new product (2.b.1.), specifically to a new type of electronic equipment (3) destined for Commercial end-use (4). N.B. You may see fit to be more descriptive.

6. If The Credit had not been available, would your company likely have...

   - **Indicate one or the other**

   .X.deferred to the future

   ....never undertaken

   the project(s) or experimental activity(ies) defined in your response to question 5.

7. If you had NOT undertaken the project(s) or experimental activity(ies) defined in your response to question 5, by what amount would the expenditures reported in question 1.a. have been REDUCED? None

8. Were there some R&D expenditures (reported in question 1.a.) for which you claimed The Credit but that your company did not include as Research Costs in reports to the Securities and Exchange Commission (SEC)? N/A

9. If The Credit were to be made permanent in 1985 legislation, how would that affect your company's long-term research-planning and -budgeting? Allocate increasing amounts.

10. If 1985 legislation were to include expenditures for Basic (pure) research (question 2.a.)...but to exclude expenditures for Applied research (question 2.b.)...how would that affect your company's long-term research-planning and -budgeting? Leveling projected research.

EIA 1984 Survey QUESTIONNAIRE

Mr. PICKLE. Our next witness will be Mr. Harry Mussman, executive vice president of the National Food Processors Association.

STATEMENT OF HARRY C. MUSSMAN, EXECUTIVE VICE PRESIDENT, NATIONAL FOOD PROCESSORS ASSOCIATION

Mr. MUSSMAN. Thank you, Mr. Chairman.

I might start by saying that I am not here as a tax specialist of any kind. I am a scientist representing the food processing industry of the United States. The National Food Processors Association, the association which I represent, is a trade association representing approximately 600 members of the food processing industry. About 450 are actual food processors in the true definition of the word. The other 150 are in the business of supplying equipment or packaging material to that industry.

My statement before you today is going to be extremely brief. At the outset, I would also like to request, Mr. Chairman, that my formal statement be entered into the record, if that is agreeable.

Mr. PICKLE. All of your statements will be included in the record.

Mr. MUSSMAN. I would comment briefly on only two points that I think need to be made. One is to emphasize our food processing industry's belief that a program of tax credits is extremely important to the development of innovative new products, new ways of packaging and new ways of marketing.

The second point I would make has to do with the food processing industry itself being eligible for these tax credits. I want to be sure that there is no doubt in this committee's mind, Mr. Chairman, that the kind of research and development being carried out by our food processing membership is indeed qualified for the tax credits that have been the subject of these hearings and the subject of the Economic Recovery Act of 1981. They are not mentioned specifically in the act currently being administered, but we would hope that in any renewal of it or extension of it, that they would be so identified, we believe that the nature of the research being carried out certainly qualifies them and justifies the tax credit being applied to them.

If I could expand very quickly on the two points, first to emphasize the industry's belief in the need for the program of tax credits. I would not try to tell this committee or my colleagues here at the table that in the absence of a tax credit program all research and development would cease. I would rather point out that in those instances where a company proceeds to a certain point and may, for reasons of high risk, determine that they want to cut their losses and not go further, the having of tax credits may make a difference as far as pursuing what could be very important research for purposes of food production.

In addition, tax credits may permit them to even undertake research which might not otherwise have been undertaken. So from that standpoint it is important. I think that would be agreed to by most everyone here.

On the second point—about food processing research qualifying for tax credits—I do not know how many people are familiar with the kind of research done. Many, I think—and I am talking about the food processing industry—I am sure many would feel that most research is of the marketing type, determining whether a product is marketable or acceptable to consumers. In fact the amount of research and development devoted to new products—fabrication of products being asked for by the consumer today—occupy a major part of the research dollar.

We have new packaging that is coming on line. The aseptic processing and packaging with which you, Mr. Chairman, and others in the room are certainly familiar—it is entering the marketplace in a very big way—permits a number of things to be done differently than ever before; it's very exciting.

A second type of research I would refer to is hyperfiltration where it is possible to fractionate liquids, reconstruct them or reconstitute them in different ways so that we end up with products that may have fewer unwanted components and more of the desirable components.

Another research area in which the food processing industry is very deeply involved is that of biotechnology. This is on everyone's lips. Certainly our industry is not the only one looking for new ways to develop plant disease resistance to increase yields, to increase flavors, to improve nutrition, and other things along those lines.

Finally, I would mention irradiation. It is a technology which has been around for a while, but certainly its application to the food industry has been relatively slow in coming. It is only now beginning to take hold and beginning to be recognized as something that may occupy a major niche in the processing industry in the future.

I mention these only as examples of the kind of research certainly that qualifies in our mind as high tech that the food processing industry is involved in.

I would conclude, Mr. Chairman, by saying that the National Food Processors Association, in taking a look at the kind of research our industry is carrying out and the research we as an association are involved in—you might be interested in knowing we have three labs of our own in which we carry out substantial research in support of the industry—can vouch for the high level of achievement of our industry in the research area and vouch also for the fact that a tax credit program is an integral part of any kind of planning for the research commitments that that industry will make down the road.

With that, Mr. Chairman, I would conclude my remarks and be happy to try to answer any questions you might have.

[The prepared statement and supplemental letter follow:]

STATEMENT OF HARRY C. MUSSMAN, EXECUTIVE VICE PRESIDENT, NATIONAL FOOD PROCESSORS ASSOCIATION

Mr. Chairman and members of the subcommittee, I am pleased to have this opportunity today to appear before you to underscore our industry's strong belief in a program of tax credits for research and deveopment. I am Dr. Harry C. Mussman, Executive Vice President of the National Food Processors Association.

NFPA is a scientifically and technically based trade association representing about 450 member companies that pack processed-prepared fruits, vegetables, meats, fish and specialty products, including canned, frozen, dehydrated, pickled and other preserved food items. Also included in our membership are about 150 manufacturers and suppliers of equipment and services for the food processing industry. NFPA members are using research and development tax credits available to them and have expressed concern that these credits might be permitted to expire the end of 1985.

The Economic Recovery Tax Act of 1981 was designed to turn around the substantial decline in the U.S. industry's expenditures for research and devlopment. It provided a tax credit to encourage businesses to perform the research necessary to increase the innovation and efficiency necessary for a solid U.S. economy.

Our understanding was that the expiration date for the program was set up to enable Congress to evaluate the benefits derived from the tax credits and make any modifications considered necessary. The benefits are only now becoming apparent and we believe it would be counterproductive to discontinue a program that will help ensure that the United States remains a leader in the development of new industrial technologies.

Research and development tax credits do stimulate research expenditures, especially in the areas of basic research and long term technology development. These are areas often neglected during times of tight money and high interest rates in favor of projects with immediate applications and payoffs.

A major concern of the food processing industry has been the recent comments of Treasury officials that they would like to limit the type of research activities qualifying for research and development tax credits. Statements have been made that some of the tax credits benefit industries that are not involved in "high technology." While many persons may not consider agriculture and food processing "high technology" industries, members of this committee should understand that today's food processing industry is highly sophisticated and continually strives to develop new technologies for processing and packaging food to ensure not only innovative, but also healthy, wholesome and safe food products for the U.S. market and the rest of the world.

We believe strongly that food and plant research conducted to develop a new or improved food product should continue to qualify for R&D tax credit. Computers, electronics, aerospace, and scientific instruments are not the only areas where technological improvements are needed.

Many food processing R&D efforts—to increase fiber, to decrease saturated fats or to eliminate certain additives—have been initiated because of health considerations. A more specific example is the extraction of caffeine from coffee by using supercritical fluids. Since this extraction method leaves no residues, it is now replacing methylene chloride in the commercial decaffeination of coffee. The same method can be used to extract aroma compounds from spices and to deodorize oils and fats. Although this process may have been developed eventually without the benefits of tax credits, there is no way to estimate how long we would have had to wait.

Some of our innovative packaging and processing technologies also might still be something in our future rather than available today. Without aseptic processing technology we would not have fluid milk in a box that is shelf stable for several months or the boil-in-the-bag dinners currently on the grocery shelves.

Once the Food and Drug Administration approve a broader range of food products for processing by irradiation, food processors will be exploring opportunities in irradiated food products. Research budgets are limited in most companies, however, and tax credits may provide the incentive to assure a strong research effort.

As to the question of whether the categories of qualifying research expenditures should be broadened or narrowed, it is premature for us to comment since we do not know the specific abuses you wish to prevent. We can only reiterate that with regard to the food processing industry which is striving to maintain a plentiful supply of wholesome, nutritious foods at reasonable cost, there appears to be ample justification for a program of research and development tax credits.

I would like to take a few moments to mention the type of research projects our food processing industry feels should continue to qualify for R&D tax credits.

Research to reduce post harvest spoilage before arrival at processing plant.

Studies to control ripening of fruit and vegetables intended for the fresh market in order to increase shelf life.

Long-range studies on non-chemical controls of plant diseases.

Studies of process innovations leading to more energy efficient technology, e.g., for the concentration of fruit juices.

Research into innovative packaging and processing to provide quality food in more convenient and lower cost form.

Studies under varied climatic conditions to develop disease resistant and higher yielding crops.

I realize that I have not covered all of the issues of interest to this subcommittee. The Food Industry wanted you to be aware of our concerns and we leave those other questions to the true tax experts testifying during these hearings.

We thank you for this opportunity and will be happy to answer any questions.

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

(a) for what year(s), and

(b) in what amount(s).

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

(a) the specific product or experimental activity that would not have been undertaken,

(b) whether such activities would have been deferred to the future or never undertaken, and

(c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

National Food Processors Association,
Washington, DC, September 17, 1984.

Hon. Charles B. Rangel,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, House of Representatives, Washington, DC.

Dear Mr. Chairman: The National Food Processors Association (NFPA) appreciated the opportunity in August to present testimony before your Oversight Subcommittee on the importance of the availability of research and experimentation tax credits to our 600 members of food processors, manufacturers and suppliers. On our members behalf, we expressed the strong belief that the agriculture and food processing industries should continue to qualify for research and development tax credits.

We do understand why you and members of your subcommittee desire more specific information as to how our member companies have taken advantage in the past of available tax credits and their plans for future use of tax credits. However, research and development is the tool by which companies upgrade and expand new products, styles and packaging, therefore, most research and development undertaken by any company is considered top secret and treated as proprietary.

As the trade association, NFPA worked to pool all the information in such a way that no company information could be identified by a competitor. However, this task proved impossible in some areas. The problem was that the research we would be talking about would be for products of the future rather than those currently in the marketplace.

For these reasons we are unable to respond to your questions (1) through (5) but we do hope our consolidated answers to (6) through (8) will prove helpful.

(6) The amounts and types of expenditures reported as "qualified" expenditures in claiming the credits but not included in reports made to the SEC were considered too minor to identify, with the SEC report being inclusive.

(7) If the credit is made permanent, long-term research budgeting and planning would grow at an accelerated pace, especially in the areas of basic research and application of those technologies.

(8) Should the definition of qualifed research expenditures be narrowed to include only basic and applied research but not the development expenditures, the general consensus is that expenditures would be shifted so that the past balance could be maintained between fundamental research expenditures and necessary expenditures for development of that research.

If we may be of any further assistance, please do not hesitate to call.

Sincerely,

HARRY C. MUSSMAN,
Executive Vice President.

Mr. PICKLE. Thank you, Mr. Mussman.

I would be interested and know the staff will be interested in reading your testimony to get some further examples about what kind of research you do.

I do not think I had in mind when we passed the R&D credit in 1981 that we were trying to help the food processing industry learn how to cook a better hot cake. I had in mind high tech research and scientific work, more than cooking.

Now, I have got to say that we did not exclude anybody, so you are entitled to have your research looked at as well as anyone else, and I think it is well for us to consider again the area of eligibility.

I get a little bit excited, we will say, about hyperfiltration and irradiation, and I am sure there are other processes that are interesting, but if we are giving credits to help you just formulate a better recipe, that is something else.

But we are going to look at your testimony closely, not negatively. I think we are going to take the time to take a good look at it, because if all businesses want to get these credits, then we are making permanent at least 25 percent credits on anything you do because there is no limit to what kind of research you can carry on. Well, that would eventually break the Government. We have to be real careful about that.

And if we are going to make these R&D credits really do what we intend, then I think we had better agree, and jointly, pretty much what are the parameters and then carry them out.

So I do not say that in a negative sense to you, but I think those are questions we will be asking. And I may submit some other questions to you, particularly when I ask you whether you are trying to improve a product or create a new one.

Mr. MUSSMAN. If we were just improving products, Mr. Chairman, I would not be here today. I am talking about prolonging shelf life and quality for long periods of time, much longer than perhaps are now available, which will permit foods to be marketed over longer periods, reducing costs, benefiting the consumer from a nutrition standpoint, economically and so on. These are significant achievements.

Mr. PICKLE. Well, in making your food last longer, you are not trying to get away with putting just old melted wax in the tops of your preserves, are you?

Mr. MUSSMAN. No, sir, a bit more esoteric than that.

Mr. PICKLE. I would hope so.

We have one other witness here, Dr. Thomas Perfitt, who is vice president of research and development for the Lear Siegler Inc., the instrument division, and you are represented, by Mr. Richard Vander Veen.

Which one of you would like to make the statement?

STATEMENTS OF THOMAS PERFITT, PH.D., VICE PRESIDENT OF RESEARCH AND DEVELOPMENT, INSTRUMENT DIVISION, LEAR SIEGLER, INC., AND RICHARD F. VANDER VEEN, MANAGER, GOVERNMENT RELATIONS

Mr. **Vander Veen**. We would like to make two very brief statements. The hour is late, Mr. Chairman, and I would like to begin my statement by thanking you for the time today to explain how Lear Siegler is affected by the R&D credit, why we think the R&D credit should be made permanent, or, at least extended over a longer period of time, to encourage our planning process, and second, why we are very much aware of the budget process, and why we must reduce our national debt.

That is a fundamental problem facing this Nation, and we want this credit to be extended in the context of full recognition of the duties of this committee of this House of this Congress to pay our debts, but to do it in a way that encourages and stimulates technological improvements.

Then I would like to wind up very briefly by explaining how Lear Siegler goes through its budgetary process in terms of developing its R&D budget each year, and what the precise effect of this R&D credit is upon it.

You raised the question earlier with another witness as to what effect this has on their budgetary process.

Mr. **Pickle**. What is your project? I know you are Lear Siegler.

Mr. **Vander Veen**. Yes; Lear Siegler is headquartered in Santa Monica, CA. It is about Fortune 225 in number. It operates 52 divisions in 21 States and employs 30,000 people. We are a very diversified company, and as such, we are very tightly managed.

Mr. **Pickle**. You say you are the instrument division?

Mr. **Vander Veen**. The instrument division is one division of those 52, at which Dr. Perfitt is the head of research.

I would like to begin by saying that we agree with other members of the panel that it is imperative that the United States extend the R&D credit on a permanent basis. This will encourage new and challenging jobs for our people, producing internationally competitive products. Extending the Federal R&D credit will send a message across this Nation that the U.S. Congress and this Nation are serious about high tech, but more importantly, about participating in the international recovery and providing good, solid, challenging jobs for our people.

The Federal budget implications are important to all of us. As I left Detroit this morning, I thought about some of the things we were doing there with research in terms of designing more innovative car seating, lighter, safer car seating, and employing people in downtown Detroit.

Critics of the proposed budget problem say that the credit reduces this Nation's ability to balance its budget. We respond, and it is our opinion in the face of this criticism that that is a very legitimate question. How much does this credit cost, and what effect are we getting for the estimated $1 billion it is going to cost next year?

I think it is fair to say that the credit stimulates research which creates new jobs and new opportunities for employment for our people, and the increased jobs will result in increased taxes, and increased taxes will help the revenue picture.

We have heard from other people that we are in effect postponing our taxes, but we think that this credit will in the end do more to stimulate economic growth, which will, in effect, bring in more revenue, and that it will in effect pay for itself.

How does it affect Lear Siegler? I should point out that we have 52 divisions and that each division annually submits a 3-year plan to corporate, that is, Santa Monica, for concurrence. These plans include several projections as to sales, percentage return on sales, percentage return on assets, where they will be a year from now, 3 years from now.

As a publicly held company, we serve several masters. We want to take care of our employees. We have community duties as a corporate citizen. We have to take care of our customers. Certainly we also have to serve the investment community, and our shareholders. Each of them can fairly claim a fair return on their investment in our company.

As long as each division's 3-year plan; 1-year plan meets the financial parameters that are consistent with corporate goals, each division is given reasonable latitude in investing its money in R&D. What I am saying is that there always are more R&D opportunities for Lear Siegler than we can possibly fund.

We go through a lot of internal debate sorting out the good ones and the bad ones, but it is the instrument division's position, together with the rest of the other Lear Siegler Michigan divisions and other divisions across the country, that the tax credit allows us to take advantage of more R&D opportunities than we could ever take advantage of without it in place.

For instance, in 1981 Lear Siegler spent $17 million on research. In 1982 and 1983, our return on sales was—we actually went down 15 percent. We suffered by the recession because we were partly automotive, we are electronics, we are aerospace, we are material handling, we are machine tools.

In the face of a 15-percent decrease in our earnings over the period of 1982 and 1983, Lear Siegler increased its research up to $30 million, a 43-percent increase. So while earnings declined 15 percent, we raised our spending 43 percent.

In conclusion, the R&D credit is a clear factor in the decision process of how Lear Siegler, Inc., spends its R&D dollars. The R&D tax credit causes this nation to create more innovative products because it provides the assistance at the margin, at the edge of making that decision to go forward or not, and it is hard to demonstrate in hard figures exactly what the effects of the credit are because there are a lot of factors that go into making a decision to go forth and do research. But the credit is clearly a factor in making that decision to go forward.

[The prepared statement and supplemental letter follow:]

STATEMENT OF THOMAS PEREFITT, PH.D., VICE PRESIDENT OF RESEARCH AND DEVELOPMENT, AND RICHARD VANDER VEEN, MANAGER, GOVERNMENT RELATIONS, LEAR SIEGLER, INC.

SUMMARY

The Research and Development Credit is creating new challenging jobs and innovative products at Lear Siegler, Inc. These products are helping the United States effectively compete in the international marketplace.

The Research and Development Credit has stimulated private sector decisions to increase R&D spending. Lear Siegler, Inc. has increased its R&D expenditures 43.7% since the first year the Research and Development Credit was in effect.

The Lear Siegler, Inc. Flight Management Computer System (FMCS), a product that used the Research and Development Credit, illustrates how progress is being made toward achieving the United States Congressional intent and purposes for the Research and Development tax credit:

(1) Stimulating innovative products.
(2) Improving U.S. productivity and economic growth.
(3) Increasing U.S. international competitive capabilities.
(4) Creating more new challenging jobs for our people.

The Federal Research and Development Tax Credit is excellent public policy because it represents the comprehensive commitment by the United States to restore the technological leadership of this nation in the world community.

STATEMENT

Mr. Chairman and Members of this distinguished Committee: Testifying today on behalf of Lear Siegler, Inc. are Dr. Thomas Perfitt and Richard Vander Veen.

Dr. Thomas Perfitt, PhD, is Vice President for Research and Development at the Lear Siegler, Inc. Instrument Division in Grand Rapids, Michigan.

Richard Vander Veen is an attorney with Lear Siegler, Inc., a diversified company which was founded in 1954, with operations in six major business segments: Aerospace, Material Handling, Industrial and Recreational Products, Automotive, Aircraft and Commercial Products.

Lear Siegler, Inc. is headquartered in Santa Monica, California and operates 52 divisions and subsidiaries, employing more than 30,000 employees.

It is imperative that the U.S. Congress extend the R&D credit on a permanent basis to encourage new and challenging jobs for our people, producing internationally competitive products.

Extending the Federal R&D credit would send a message across the U.S.A. that this nation is serious about high technology and about sustaining the international economic recovery. The credit would assist existing employers, such as Lear Siegler, Inc., to grow and succeed. By promoting high quality products and processes, the credit would create new and challenging private sector jobs.

FEDERAL BUDGET IMPLICATIONS: THE R&D CREDIT PAYS FOR ITSELF

Critics of the proposed research and development credit claim that the resulting loss of tax dollars will reduce the nation's ability to balance its budget. We respond to this criticism by pointing out that in the long term, every dollar invested in this effort through short run tax incentives will be replaced through taxes levied on the increased income of new employees and employers on a national level.

THE R&D CREDIT HAS INCREASED R&D EXPENDITURES BY LEAR SIEGLER, INC.

With respect to the question raised by the Committee regarding the spending and allocation of the R&D budget of Lear Siegler, Inc., we can best answer the question by illustrating the budget decision process of our diversified corporation.

Lear Siegler, Inc. serves many masters including the investment community, our stockholders, and the technological demands of thre future. Each of the 52 divisions of LSI annually submits a three year plan to corporate for concurrence. These plans include projected sales, percentage return on sales and percentage return on assets. As long as these financial parameters are consistent with corporate goals, each division is given reasonable latitude in investing money into R&D. Typically there are more viable R&D opportunities than there are available funds. The tax credit allows us to accomplish more of these R&D opportunities.

Lear Siegler, Inc. devoted $30,900,000 in 1983 and $28,500,000 in 1982, both recession years, to research and development compared to $17,400,000 in 1981. This amounts to $1,545 per LSI employee worldwide, a 43.7% increase in R&D expenditures by Lear Siegler, Inc. since the first year the Research and Development credit was enacted. The availability of the credit was a major factor in encouraging this increased investment in R&D.

THE FLIGHT MANAGEMENT COMPUTER SYSTEM (FMCS)—A RESULT USING THE R&D CREDIT

Proponents of the Research & Development Credit point to the Congressional intent of the research and development credit and exclaim: "Extend it; make it permanent!" We join in this declaration today by illustrating one product that was developed with increased research and development expenditures by Lear Siegler, Inc.: The LSI Flight Management Computer System (FMCS). The FMCS was developed in Grand Rapids by the LSI Instrument Division. Investment in the FMCS is over $20 million, almost all directly in local engineering salaries which were "Qualified Research & Development" expenditures under Section 44F of the Internal Revenue Code. The Flight Management Computer System was designed and is used in the Boeing 737-300 commercial aircraft. Through the FMCS, Lear Siegler, Inc. is helping to achieve several of the key goals of the R&D Credit.

(1) CONGRESSIONAL GOAL: STIMULATE INNOVATIVE PRODUCTS

The FMCS was judged in 1983 by an engineering industry association—State Government panel as the winner of the Governor's New Product of the Year Award in Michigan.

The Governor's New Product Award is announced during Michigan Week and is sponsored by the Greater Michigan Foundation in cooperation with the Michigan Society of Professional Engineers, the Michigan Manufacturer's Association and the Michigan Department of Commerce. The award recognizes the creative development of new products and the use of technological and engineering talents. Consideration is given to design innovation, engineering ingenuity, product appearance, safety and benefit to the user, and the economic contribution to the state. Judges were representatives from the sponsoring organizations and academic Deans of Engineering schools.

(2) CONGRESSIONAL GOAL: INCREASE U.S. PRODUCTIVITY

The Lear Siegler Flight Management Computer System translates data from several aircraft systems and, integrated with the autopilot and autothrottle, automatically "flies" the aircraft in both the vertical and lateral flight profile. As a result, pilot workload is reduced, which supports the reduction of crew members from three to two. Also, the Flight Management System flies the aircraft at the best speed and altitude to maximum fuel efficiency which is critical in today's commercial aircraft market. System use results in a fuel saving of 3-15% depending upon the configuration and the airline route structure.

The FMCS can also include time parameters for optimum schedule coordination and promotes safety by linking in with all national ground traffic controllers.

(3) CONGRESSIONAL GOAL: INCREASE U.S. INTERNATIONAL COMPETITIVE CAPABILITIES AND LOWER NEGATIVE TRADE BALANCE

Commercial aircraft rank among the largest, most valuable U.S. exports. The projected commercial aircraft market for the next decade is over $7 billion. The LSI Flight Management Computer System is significantly aiding the Boeing Company in making the 737-300 one of the world's most competitive commercial aircraft. Faced with the growing competition from the government subsidized European Consortium—AIRBUS—we believe the FMCS is a step in improving the competitiveness of U.S. commercial aircraft and thereby helping to reduce our trade deficit.

(4) CONGRESSIONAL GOAL: STIMULATE EMPLOYMENT

The LSI FMCS has and will continue to increase employment opportunities for Lear Siegler, Inc. and Boeing. Over the past few years between 150-200 engineers have been and are involved in the FMCS project. A significant number of hourly employees, represented by the United Auto Workers, are and will be required to manufacture the FMCS.

It is significant that the final competition for the Boeing 737 Flight Management Computer System was between Lear Siegler and Smiths Industries of the United Kingdom. Lear Siegler was evaluated as the lowest risk contractor by Boeing and awarded the production contract. The R&D performed on the Flight Management Computer System prior to the competition is directly traceable to Lear Siegler's lower risk approach. Had we lost the competition, the production revenue and production jobs would have been lost to the United Kingdom.

R&D CREDIT: CRITICAL TO LSI OPTICAL GYROSCOPIC RESEARCH AND DEVELOPMENT

A further example of the criticality of research and development to all LSI Instrument Division employees is its relationship to our gyroscopic products. Mechanical gyroscopic products presently account for approximately $40 million in revenue per year at the Instrument Division.

Our competitors—Thomson CSF of France, for example—are developing optical gyros that ultimately will be lower cost and more reliable than mechanical gyros. The LSI Instrument Division is currently spending over $750,000 per year in optical gyro research. It is imperative that we accelerate this level to meet our competition in the future. If we fail, a substantial number of jobs currently dedicated to mechanical gyros could be lost when our customers select an advanced optical gyro in future years. Many of our jobs could go to foreign competitors. We don't want that to happen.

CONCLUSION

In conclusion, Lear Siegler strongly urges the United States Congress to make the Research and Development tax credit permanent. This action would continue to encourage United States business to invest in research and development in order to protect our existing jobs, create new U.S. jobs and provide a continuing incentive to business to continue to create innovative products. This public policy will help the U.S. restore its role as a technological leader in the world community.

Lear Siegler, Inc.,
Lansing, MI, August 14, 1984.

Hon. Charles Rangel,
House of Representatives,
Rayburn HOB, Washington, DC.

Dear Representative Rangel: Lear Siegler, Inc. appreciated the opportunity you and the U.S. House Ways & Means Oversight Subcommittee provided to testify on behalf of the Research and Development Committee.

The Research and Development Tax Credit is an investment in the future in the truest sense. The R&D Credit does provide Lear Siegler, Inc. and other employers with a leveraged, dynamic source of capital to undertake more research and development.

In our testimony, August 2nd, Dr. Thomas Perfitt, V.P., Research LSI Instrument Division and I emphasized that the LSI Flight Management Computer System was developed, in part with funds spurred by the R&D Credit. The LSI FMCS provides tangible evidence of how the U.S. Congressional intent for the Credit is being fulfilled:

(1) Stimulating innovative products.
(2) Improving U.S. productivity and economic growth, thereby replacing tax revenues invested in R&D.
(3) Increasing U.S. international competitive capabilities.
(4) Creating more, new challenging jobs for our people.
(5) Restoring the technological leadership of this nation in the world community.

We look forward to working with you, the Commitee, other Members and the U.S. Senate to make permanent this excellent public policy set forth in the Federal Research & Development Tax Credit.

Sincerely,

R.F. Vander Veen,
Manager, Government Operations.

Mr. Vander Veen. To provide a precise example of what I am talking about in terms of a product that you will like to hear about, Dr. Tom Perfitt is here today. He is the vice president, research and development, LSI Instrument Division. He would like to talk to you about a product which addresses several of the key goals that this committee and this Congress had when they wrote the credit.

Mr. **Perfitt**. Yes, Mr. Chairman. The division I am from is probably one of the highest technological divisions of Lear Siegler, and our business is electronics and reference systems for airplanes and military vehicles and commercial aircraft. I would like to touch on a couple of products just as examples that use, and I think effectively use the tax credit.

The first one that used it is the Siegler, Inc., flight management computer system [FMCS]. I think it satisfied a number of criteria, and I will go through those criteria. The LSI FMCS is a device, a digital computer, and its software, the program that makes it smart, and displays that go on the new Boeing 737 aircraft. Boeing has a new model coming up called the 737-300. This aircraft is in competition, of course, with the government-subsidized Airbus Industries of Europe. The LSI computer can fly the aircraft automatically, from takeoff, to touchdown.

The LSI FMCS allows the pilot to communicate with the ground controllers and sit back and manage the aircraft, but the computer is actually flying the whole aircraft. In the process of flying it, it does some things from a scientific nature that came out of development. The FMCS optimizes fuel, by flying the aircraft at the best altitude and best speed.

The significant thing on this, I believe, is what it is doing to the aircraft. It is increasing the productivity of the 737 in two ways. One, it is cutting the fuel consumption, improving the fuel efficiency by between 5 and 15 percent, depending upon the configuration of the aircraft and the route structure, and so forth, a substantial saving in fuel.

And the biggest thing, it is improving the productivity of the aircraft by reducing the pilot workload and potentially permitting the three-man crew to be reduced to two. So that is a couple of ways the LSI FMCS increases productivity. The LSI FMCS also provides international competition not only for our product but for the Boeing aircraft. For example, against the international competitors, it is a substantial reduction of the pilot workload.

I think an interesting thing that came about in this product was the final competition on this computer to fly the aircraft, the flight management computer systems. The final competition occurred between Smith's Industries, which is a company very similar to our division, located in England, the United Kingdom. We were selected by the Boeing Co. to supply the FMCS even though we were slightly higher in cost, because we had less risk, and the reason we had less risk is we had done a sufficient amount of research and development that demonstrated that the concept was reasonably feasible.

So we were awarded the contract to do both the development and production. Had we not done that, we would have lost both the production jobs and the development jobs to the United Kingdom.

It is very tangible. It is an example, but I think it illustrates what benefit this tax credit is having.

In terms of stimulating new jobs, of course, there are about 200 engineers working on the development of the LSI FMCS. We are just starting production, and there is a substantial amount of production, people producing the device in Michigan represented by the United Auto Workers.

Mr. **Pickle**. Would you have produced that digital computer if you had not had the credit?

Mr. **Perfitt**. That is a difficult question to answer as everyone has said. We probably would have done something. I think the credit encouraged us to do more, and I can illustrate this again by what Rich was alluding to in terms of our budgeting process. We have to return so much money to corporate to satisfy our stockholders and the investment community, and that is why we are in business, of course. And there then would be a chunk of money left over.

Now, that chunk of money is modified by how much we are going to have to pay our corporate headquarters for loaning money, how much money they are going to give us back in taxes. So the tax credit changes that total amount of money that we invest into research and development. We have a large list of good ideas. We have dismissed the bad ideas, and generally there are insufficient funds within this pot of money to fund even the good ideas.

So I can say that the tax credit was a major influence, but I cannot say that it is black and white, that had we not had the credit, we would not have done the development, or that it was directly responsible. But it was an influence.

Mr. **Pickle**. It may be difficult for each of you to say clearly in black and white whether you would or would not have done it. I am sure it helps. But we have got to be certain that it is enough of an incentive that you would do an extra amount of R&D that you might not have done otherwise.

Mr. Vander Veen, what did your firm claim for R&D credits for, let's say, 1982, 1983, and 1984?

Mr. **Vander Veen**. Approximately $700,000 in 1982, about $800,000 in 1983, and this year about $945,000 as the credit.

Mr. **Pickle**. Now, another firm, Apple, testified they used upward of $4 million or $5 million.

Mr. **Vander Veen**. Actually, we are slightly smaller, but we are so diversified that—we are so spread out. We produce windshields and we produce ironing boards, and we do not do much research in the ironing board industry. We are proud to lead the market there, but there are some divisions that do not do much research. Actually, one of the problems is that a number of divisions will be very research intensive and one of the divisions will have no research, therefore, the total base period will not grow larger than the previous 3 years, but then that the credit itself, while we have been able to claim a credit, has got to continue to expand further research expenditures.

Mr. **Pickle**. Well, I can see why in your case you would have more diversity.

Mr. **Vander Veen**. We have 400 different product lines.

Mr. **Pickle**. I want to repeat for you gentlemen a question about which we probably will get in touch with you in writing.

We would like to know whether your firm claims the research tax credit, for what years, and for what amount; and secondly, the specific types of research activities for which your firm claimed credit.

Third, we want to know whether the research was related to basic research, improvement of an existing product, or the development of a new product.

There may be other information along these lines that you would want to submit or want to clarify, and I can understand that. So we hope you will get this information to us as quickly as possible.

[The following was subsequently received:]

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

(a) for what year(s), and

(b) in what amount(s).

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

(a) the specific product or experimental activity that would not have been undertaken,

(b) whether such activities would have been deferred to the future or never undertaken, and

(c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

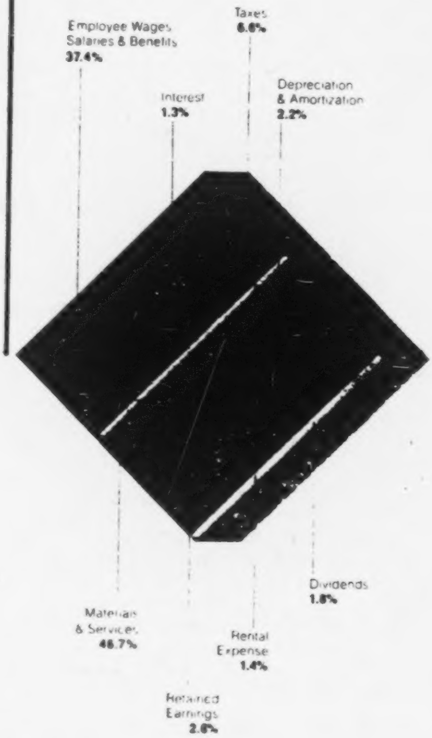
(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

DISTRIBUTION OF THE SALES DOLLAR

Materials & Services	$ 683,620,000
Employee Wages, Salaries & Benefits	547,030,000
Taxes (Income, Property, Payroll and other)	96,000,000
Depreciation & Amortization	32,786,000
Interest	19,715,000
Rental Expense	20,917,000
Dividends	25,935,000
Retained Earnings	38,187,000
Total Sales	$1,464,190,000

LSI's net profit of $64,122,000 represents 4.4% of total sales. Of this amount, more than 40% was paid to shareholders in dividends.



Every $44,000 LSI invested in R&D represented $1,000,000 in FY 1983 sales by Lear Siegler, Inc.

Therefore, the $20,634,523 LSI spent for R&D projects in FY 1983 represents over $468,000,000 in sales

(8) LSI support passage of H.R. 4475, and the substantive changes narrowing (QREs) in H.R. 4475.

The benefits of the R&D Credit on a permanent basis will be returned to R&D projects, encouraging technological growth, increased productivity and new, challenging jobs for our people.

The federal Research & Development Tax Credit is excellent public policy because it represents the comprehensive commitment by the United States to restore the technological leadership of this nation in the world community.

Lear Siegler, Inc. urges that the U.S. Congress act to make permanent the R&D Credit.

Sincerely,
Lear Siegler, Inc.
R. F. Vander Veen

LEAR SIEGLER, INC.

Mr. John J. Salmon
Committee on Ways and Means
1102 Longworth House Office Building
Washington, D.C. 20515

September 17, 1984

Dear Mr. Salmon:

To supplement the testimony Lear Siegler, Inc. presented August 2nd, we respond as follows to the questions posed by the Ways and Means Oversight Subcommittee with respect to the research & Development Tax Credit:

(1) Lear Siegler, Inc. claimed the following R&D Tax Credit:

FY 1982	6/30/82	$1,121,885
FY 1983	6/2/83	$ 968,655
FY 1984 To Be Filed	3/15/85	$ 945,545 est.

(2) - (3)

The U.S. Congressional intent for the R&D Tax Credit has been fulfilled, in part, by the development and introduction of specific products designed and engineered by Lear Siegler, Inc. utilizing the R&D Credit.

Specific R&D Projects carried out with R&D dollars that were "qualified research expenses" per SS 44F and 174 of the I.R.C. follow.

The Congressional intent of the R&D Credit was fulfilled, in part, by the development and introduction of specific products such as the LSI Flight Management Computer System (FMCS).

The FMCS is designed for commercial aircraft. The FMCS collects and translates data from several aircraft systems and - when integrated with the autopilot and autothrottle - automatically controls the aircraft in both vertical and lateral flight profiles for maximum fuel efficiency. The FMCS was described in great detail in the August 2, 1984 written and oral testimony presented to the Oversight Subcommittee.

216½ N. CHESTNUT, LANSING, MI 48933

In sum, the FMCS is a product which illustrates how progress is being made toward achieving the U.S. Congressional intent and purposes for the Research & Development Tax Credit:

(1) Stimulating innovative products

- the LSI FMCS won the 1983 Michigan Governor's Product of the Year Award: This award was presented based on a competitive consideration of design innovation, engineering ingenuity, product appearance, benefit to the user and economic contribution.

(2) Increasing U.S. Productivity

- the LSI FMCS promotes productivity and efficiency in the commercial aircraft's

- Fuel: System results in 5% fuel savings
- Time & Distance: Through precise navigation and guidance computation.
- Equipment: FMCS monitoring assures that related equipment failures are promptly and accurately isolated, translating into accurate airplane turn-around times. Coupling with autopilot and autothrottle assures maximum economy engine life, passenger comfort and safety.

(3) Increase U.S. International Competitive Capabilites

- The FMCS will assist the Boeing 737-300 to meet and beat the stiff international competition posed by the government subsidized European consortium - AIR BUS Industries. It is significant that the final competition for the Boeing 737 Flight Management Computer System was between Lear Siegler and Smiths Industries of the United Kingdom. Lear Siegler was evaluated as the lowest risk contractor by Boeing and awarded the production contract. The R&D performed on the Flight Management Computer System prior to the competition is directly traceable to Lear Siegler's lower risk approach. Had we lost the competition, the production revenue and production jobs would have been lost to the United Kingdom.

LSI Aircraft

Lear Siegler, Inc. Aircraft Group engineers, markets and manufactures a complete line of single and multi-engine piston and propjet powered general aviation aircraft. Models include executive propjets, commuter airliners, special mission planes and general purpose aircraft for both civilian and military applications.

The LSI Aircraft Group has recently performed research & development in two major new product development areas:

(1) Malibu - a new pressurized, single engine airplane. This is an entirely new aircraft which increased the technological base of Piper aircraft.*

- In engineering the LSI Piper Malibu from scratch the Piper Aircraft Corporation utilized the R&D Credit to design an entirely new aircraft.

Several Congressional Goals for the R&D Credit are being achieved by the LSI Piper Malibu:

(a) Stimulate Innovation:

"The Malibu is the most significant light general aviaiton airplane to appear in decades. Engineers started with a blank sheet of paper to make Malibu the first piston airplane designed intentionally for high-altitude operations...There's no question that the all-new Malibu is the shape of things to come, " wrote FLYING magazine (March 1983).

° Malibu is the world's first, fastest (234 kts - 270 mph) production pressurized, six-place cabin-class single engine aircraft.

(b) The Malibu increases productivity and promotes energy savings. At 205 kts, 14 gph and 81 nautical seat miles per gallon are achieved, permitting a flight range of 1,420 nautical miles with 120 gallons of fuel.

(c) The Malibu is a competitive airplane combining high performance and economy in the world's first cabin class pressurized single aircraft.

*Attached Malibu materials

(2) Cheyenne

- LSI Piper Aircraft has also developed a 400 mph turbo-prop., 6-8 place high altitude (41,000 feet) aircraft, the Cheyenne IV.

LSI Piper Aircraft utilized the Research & Development Tax Credit, in part, in designing, engineering and preparing for the aircraft market the Cheyenne IV.

U.S. Congressional Goals for the R&D Credit are being fulfilled by the development of the Cheyenne IV.

(a) Innovation: Piper Aircraft has created a new, state-of-the-art aircraft. Piper's highly qualified team of engineering specialists developed and integrated a unique combination of airframe, powerplant (Garrett Turbine Engines) and propellers (Dowty-Rotol Co.) and avionics for the Cheyenne IV project.

(b) Productivity Increased The Cheyenne IV project will fly at speeds up to 400 mph using considerably less fuel (35-40% less) than the most frugal business jets flying the same mission.

Range, payload and block time figures are equally important to consider in measuring the productivity increases and operational cost savings gained by the Cheyenne IV.

LSI Automotive Seating

The 1984 car seating research performed by Lear Siegler, Inc. can be broken down into the following categories:

I. Basic Research

(a) Foam Lab - These expenses are related to the research of foam and foaming techniques for automotive seating.

II. Improvement of Existing Products

(a) High-Performance Seats - Expenditures including improving the over all comfort and adding new features.

III. New Product Development

(a) Molded in Place - (C/K) - a new process by which automotive seats can be produced and trimmed in one basic operation.

(b) Mark VII - a new seat for the Lincoln Mark VII incorporating new features including a "European" look and pneumatic lumbar.

(c) S.A.E. Show Seat - a radical new design using space age styling, new methods of pneumatics for bolster adjustments, and a thin shell design to "open" up the space inside the cars of the future.

In the past several years, the automotive seating market has both expanded and changed the scope of involvement required by suppliers. Lear Siegler, Inc. is now more involved in the actual engineering and design of whole seating systems, thus requiring increased R&D expenditures. Should LSI face another economic downturn, the existence of the tax credit might allow us to continue many of the R&D projects that would otherwise be severely impacted or dropped altogether.

LSI Automotive Pattern Technology

Lear Siegler, Inc., through recent R&D efforts, has further advanced its capabilities in two innovative technologies used to create higher quality, cost-competitive metal, wood and plastic foundry patterns:

(a) Computer-Aided-Design/Computer-Aided-Manufacturing (CAD/CAM)

CAD/CAM yields dramatic productivity improvements in both the design and the manufacture of foundry tooling and enables Lear Siegler, Inc. to receive customer specifications via computer, without the age-old physical transfer of blueprint drawings.

(b) The Lost-Foam Process

The manufacture of automotive patterns to make covers for the production of castings through the Lost-Foam Process, sometimes called the "evaporative-coating" process. The Lost-Foam Process of making castings enables more mating parts to be produced in a single mold. This process, developed using the R&D Credit, increases the accuracy of the casting and reduces machining requirements.

Through the foresight of its people, Lear Siegler, Inc. invested early in CAD/CAM and Lost-Foam. This R&D investment has significantly enhanced the international competitive capability of the company by extablishing Lear Siegler, Inc. as the industry leader in these two technologies.

LSI Truck Suspensions

Lear Siegler, Inc. is the leader in the design and manufacture of heavy duty truck-trailer suspension systems. Our strong suit has been our engineering capability which has given us the edge in the specialty suspension business.

LSI Truck Suspensions (Cont.)

LSI has introduced many new products in the trailer and truck suspension markets in the past few years. These products were lighter in weight and lower cost which produced much needed improved productivity in the trucking industry. Improved suspension performance in terms of better ride and reduced vibration damage give fleet operators an advantage in maintaining their equipment making it useful for a longer period of time.

In addition, researching new manufacturing techniques and improved designs for manufacturability have produced improved productivity amounting to the millions of dollars savings for our particular company.

Needless to say, all of these things have been much needed and have helped to keep our company, and indeed our industry, in a competitive postition.

The R&D credit that LSI receives is a major component in the availability of funds for new equipment and technology for the continuation of these productivity improvements. These improvements have made us more competitive with foreign, as well as domestic, competitors. We have consequently been able to bring our employment levels back to pre-recession magnitude and maintain them over a longer period of time.

LSI Agricultural Equipment

In the Farm Equipment area, Lear Siegler, Inc. has placed the majority of our R&D emphasis these past two economically austere years on fertilizer placement, seeding and herbicide application in a conservation tillage environment.

One of our major product lines is an Air Seeder which is a small grain seeding/fertilizing implement which distributes seed and/or fertilizer into the soil as the ground is being tilled with either a secondary (field cultivator) or a primary (chisel plow) tillage tool. The R&D efforts have been to re-design and expand the use of this tool so as to place large quantities (700 tons/acre vs. 150 tons/acre) of fertilizer in bands (thus the name fertilizer bander) into the ground approximately two inches below the seed as opposed to the conventional method of spreading it on the surface of the ground. This concept allows for the use of less fertilizer in a more strategic location, that is, in a location where the seed roots will go down to the fertilizer and in the direction of the more moisture laden soil.

This implement, along with our other implements, is being designed to accommodate the newest trends of conservation tillage (as opposed to clean tillage). This method leaves much trash (stubble & stalks) on the surface after tillage so as to prevent wind and water erosion, but requires more chemicals for weed control, and more trash tolerant tillage equipment to prepare the soil for the following season's planting.

LSI Agricultural Equipment (Cont)

Approximately 85% of Lear Siegler, Inc. Air Seeder sales are sold in the Prairie Provinces of Canada, consequently the R&D efforts must design in manufacturing savings so that we may compete with the Canadian manufacturers who have a definite currency exchange advantage. The designs must also make the machines more versatile so that they are more readily accepted in the corn and soybean areas of the U.S., thereby expanding the market beyond the small grain regions.

A couple of years ago we experienced the infiltration of a Canadian grain auger manufacturer into our market in a few northern states. Their quality is almost as good as ours and their prices were considerably lower, due primarily to the exchange rate. To combat this we developed two lower cost augers. The first was a bust; the second has been very effective. Our research and development costs were high during this period, however, they were necessary to hold our market share. This product development has enabled us to keep our productivity relatively good and keep our employment levels stable.

Because of the tax credit we were able to maintain a higher level of personnel in our R&D area. Consequently, it had direct impact on our timely reaction in this situation. Without this tax credit we would have reacted but likely not as quickly.

LSI Electric Furnace

Lear Siegler, Inc. conducted Research and Development towards reducing the cost of an electric furnace for sales to the manufactured housing industry. In an effort to increase the quality and competitiveness of the LSI furnace in a selected portion of the market, the R&D Credit assisted this effort and helped leverage the R&D dollars.

LSI Plastic Traffic Channelizer

Lear Siegler, Inc. also expended R&D dollars to develop a plastic traffic channelizer. This product promotes highway safety for workers and the driving public, while reducing the liability exposure of state governments. Innovation was a key Congressional goal furthered by the use of the federal R&D Credit in this instance.

LSI Digital Hearing Aid

Lear Siegler, Inc. utilized the R&D Credit to develop a digital hearing aid, replacing analog systems and greatly increasing the hearing ability of individuals.

Lear Siegler, Inc. pursued the research and Development of this revolutionary, digital hearing aid with university contracted research and development. The new LSI digital hearing aid improves hearing significantly.

LSI Telecommunication Equipment

Another example of an innovative, competitive product researched and developed by LSI is the adaptive repeater. Telecommunications line treatment equipment has been improved as the result of the new LSI adaptive repeater. Only a significant investment in R&D by LSI using, in part the R&D Credit, permitted Lear Siegler, Inc. to develop the telecommunications systems.

LSI Material Handling System

Lear Siegler, Inc. utilized in part, the R&D Credit, to develop the LSI Production Management System (PMS) for light manufacturing and assembly operation. (Reference: LSI PMS Materials). The LSI PMS is a material handling system which was researched and developed to meet the needs of industries where product designs, product mix, processing sequences, production quantities and delivery schedules change frequently.

Several U.S. Congressional goals for the credit are furthered by the LSI Production Management System:

(1) Stimulate Innovation: the LSI PMS improves facilities usability by reducing set up times;

(2) Increase productivity

- The LSI PMS expedites assembly and test operations.
- The LSI PMS supports various assembly strategies (re Work-In-Progress, batch progressive, and/or progressive sequential).
- Improved control of assembly operations results through the closed-loop communication with each work station.
- Productivity is additionally enhanced by the LSI PMS by providing real-time shop floor visibility for all assembly functions.

(3) Increase competitive capabilities

By increasing facility utilization and therefore productivity, the LSI Production Management System increases inventory turnover. This relates to higher Work-In-Progress (WIP) inventory velocities (turnovers), which can lead to reducing work-in-progress inventory levels and their necessary handling cost. WIP inventory reduction will reduce overhead burden and ultimately the total cost of manufactured goods.

Clean, simple conveyor design, with concealed air, electrical and communications hookups provide a safe, quiet and pleasant work environment. The LSI PMS is suitable for clean room environments, too. The sleek design of the LSI PMS is visual and dramatic evidence of our commitment to productivity and progress. Making permanent the R&D Tax Credit will help assure that future R&D dollars continue this growtj effort.

Office Furniture System

Lear Siegler, Inc. has further allocated R&D dollars using the R&D Tax Credit to create the LSI "Sigma 2000". A new concept in contract office furniture.

The objective of the Sigma 2000 project was to create a simple, efficient and productive office system responsive to three vital human relationships: interaction with fellow workers, with machines and with the work environment.

The LSI Sigma 2000 provides work surfaces that are easily adjusted by the user while seated at the work station - increasing comfort and productivity.

Data transmission, communication and power wiring are simplified by the LSI Sigma 2000's unique wire management system.

The LSI Sigma 2000 work station system offers a wide range of filing configurations for both paper and electronic media further increasing office productivity.

(4) It is difficult in a business environment to say what would have been done were the R&D Credit not in place. Without the R&D Credit, R&D efforts would have been less comprehensive and schedules would have stretched out. Further, the fundamental U.S. Congressional goal for the credit outlined above would not have been advanced to the degree that they have.

(5) Several factors are taken into account by LSI in deciding to pursue R&D projects. Market opportunities, customer needs, potential technological solutions, available personnel and expertise, the risk envolved and potential return on investment and limited financial R&D resources are among the factors LSI takes into account, together with the R&D Credit, in conducting research and experimentation activities.

The federal R&D Credit is a key factor, but not the only factor, when LSI makes its choices in allocating scarce financial resources to R&D.

(6) Lear Siegler, Inc. Research & Development Costs

	SEC Report	Difference	Tax Filing per §§44F & 174 I.R. Qualified R&D Expense
FY 1982 6/30/82	$28,500,000	(7,955,033)	$20,544,967
FY 1983 6/30/83	$30,900,000	(10,256,477)	$20,634,523

Lear Siegler, had significantly lower (qualified research expenses) than the R&D totals reported to the S.E.C.

(7) Lear Siegler, Inc. urges the U.S. House Ways & Means Subcommittee and the full House to pass H.R. 4475, a bill to make permanent the R&D Tax Credit.

Making the Research and Development Tax Credit Permanent will send an important signal to chief financial officers, research scientists and universities. That message will be that the U.S. Congress fully supports the continued, accelerated investment in U.S.A. research and development.

Making permanent the R&D Credit will assist Lear Siegler, Inc. and other U.S. employers to leverage more, scarce Research & Development dollars to worthy, but underfunded projects.

Future U.S. technological growth will be stimulated by a permanent R&D Credit.

The long-term focus, so important when investing in R&D projects, will be promoted by making permanent the R&D Credit. Long-term R&D budgeting and planning is needed on a national scale. A permanent R&D Credit will provide a much needed long-term incentive to allocate R&D dollars, each of which is a "direct hit" on the bottom line, (i.e, every dollar devoted to R&D comes from net profits).

DISTRIBUTION OF THE SALES DOLLAR

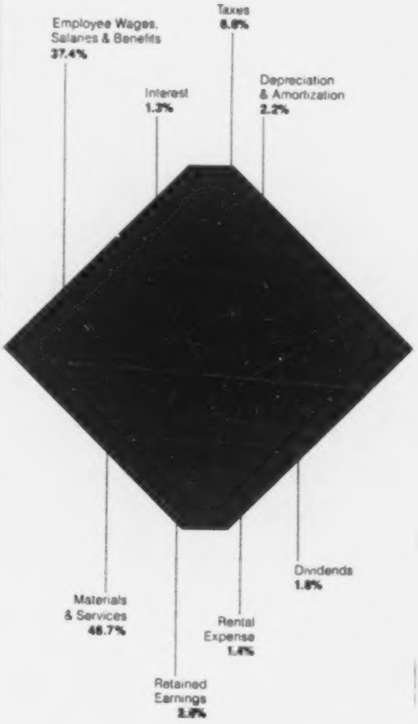
Materials & Services	$ 683,620,000
Employee Wages, Salaries & Benefits	547,030,000
Taxes (Income, Property, Payroll and other)	96,000,000
Depreciation & Amortization	32,786,000
Interest	19,715,000
Rental Expense	20,917,000
Dividends	25,935,000
Retained Earnings	38,187,000
Total Sales	$1,464,190,000

LSI's net profit of $64,122,000 represents 4.4% of total sales. Of this amount, more than 40% was paid to shareholders in dividends.

Every $44,000 LSI invested in R&D represented $1,000,000 in FY 1983 sales by Lear Siegler, Inc.

Therefore, the $20,634,523 LSI spent for R&D projects in FY 1983 represents over $468,000,000 in sales

(8) LSI support passage of H.R. 4475, and the substantive changes narrowing (QREs) in H.R. 4475.



The benefits of the R&D Credit on a permanent basis will be returned to R&D projects, encouraging technological growth, increased productivity and new, challenging jobs for our people.

The federal Research & Development Tax Credit is excellent public policy because it represents the comprehensive commitment by the United States to restore the technological leadership of this nation in the world community.

Lear Siegler, Inc. urges that the U.S. Congress act to make permanent the R&D Credit.

Sincerely,
Lear Siegler, Inc.
R. F. Vander Veen

Mr. **Pickle**. Now, we know that we will have these hearings continued tomorrow at 10 o'clock in 1100 Longworth. These hearings will be continued, and it may be that we will have other types of questions that we want to submit to you other than what I have asked you here. We hope you would give us your quick cooperation because we are trying to gather the data and the information.

The chairman promised the Congress, that we would hold these hearings just as quickly as possible. Now we are getting right into the question about getting as much information as we can. So I know you will cooperate.

Do any of you have any additional statement or information you want to make at this time?

If not, I thank you. I know this has been a long hearing, and our committee has been in markup this morning on the Superfund, so the chairman superseded you with regard to a lot of our members. That is why we did not have more people here. But we are intensely interested in the subject.

We thank you for your cooperation.

The committee will stand adjourned until tomorrow morning at 10 o'clock.

[Whereupon, at 2:45 p.m., the subcommittee adjourned, to reconvene at 10 a.m., Friday, August 3, 1984.]

RESEARCH AND EXPERIMENTATION TAX CREDIT

FRIDAY, AUGUST 3, 1984

House of Representatives,
Committee on Ways and Means,
Subcommittee on Oversight,
Washington, DC.

The subcommittee met at 10 a.m., pursuant to notice, in room 1100, Longworth House Office Building, Hon. Charles B. Rangel (chairman of the subcommittee) presiding.

Chairman **Rangel**. The subcommittee will resume its hearing. Yesterday we heard from several witnesses. Today we will hear from Members of Congress, the Chamber of Commerce, associations, R&D firms, and university groups. We will then be prepared to report to the full committee.

Our first witness is one of the most outstanding Members of Congress from California, the Honorable Norman Mineta. The committee welcomes you personally and your testimony.

STATEMENT OF HON. NORMAN Y. MINETA, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. **Mineta**. Thank you very much, Mr. Chairman and members of the subcommittee for giving me the opportunity to appear this morning. In light of the fact that the research and development tax credits expire next year, we must begin to build a fund of knowledge—statistical where possible and subjective where it is not—so that we can debate the merits of a permanent extension.

Mr. Chairman, it is my belief that it would be wise public policy for us to make this credit permanent and it is my hope that this subcommittee and ultimately the full Ways and Means Committee will concur.

One of the few assumptions about our economy that is universally accepted is that innovation—and the research and development process preceding innovation—are essential to a dynamic and fruitful economy. Innovation and the new products and processes that ensure increased productivity, boost the international competitiveness of domestic industry and lays out the foundation for the next generation of industries and the corollary goods and services they spawn.

We know that there is a high correlation between research and development and international competitiveness. Those kinds of industries which devote enormous resources to product development are the ones which are our best international competitors. Those industries with severe global competitive problems invest significantly less in research and development.

While there are a number of complex factors which have contributed to the competitive decline in such industries as automobile and steel, we must count among those factors a deteriorating American technological advantage.

To us, steelmaking, for example, is largely an industrial process; for the Japanese, it is also regarded as a chemical process and improvements in the steel alloy itself command considerable research and development expenditures.

Because research and development is so intrinsically linked to our national wellbeing, the Government has a certain responsibility for the overall technological performance of the economy. To some extent, we accomplish this by direct grants to universities, disbursement of funds through the National Science Foundation and its sister institutes, and maintenance of national laboratories.

Moreover, many strides on the civilian side have come about by virtue of defense related R&D and as a result of contracting by individual government agencies with private industry.

However, hard as we may try, the Government cannot replicate the mix of elements essential to genuine innovation. We ourselves cannot generate the intellectual skills, the body of scientific data, the inspiration, and the perceptions of market opportunities which together produce innovations and, hopefully, profitability. This kind of activity belongs quite rightly in the private sector. It is, however, the proper role of Government to provide the incentives that market forces alone do not provide for private firms to fund the R&D needed to ensure rapid rates of innovation.

Research and development spending is regarded differently than other investments a company is likely to make R&D is riskier—the rewards may be a long time in coming or they may never come at all. When measured against increased production capability for existing products or other internal improvements, R&D spending may lag behind.

A company may well understand the need for innovation but the market incentives alone cannot always justify borrowing at inflated interest rates or investing limited funds in highly speculative ventures.

Therefore, as the market forces are relatively volatile and uncertain, the Government can use the tax code—which is, by design, equipped to produce desirable developments in our economy—to stimulate greater R&D investment than a company might otherwise be able to sustain.

Let me, for a minute, describe a recent tour that I made of Advanced Micro Devices, one of the world's largest producers of integrated circuits, located in Sunnyvale, CA. Since my congressional district encompasses some of Silicon Valley, which I have the honor of representing with Congressman Zschau and Congressman Edwards, I visit companies like AMD on a regular basis.

The company is new—just 15 years old—and, as you would expect, highly entrepreneurial and fast paced. No question but that it is a highly charged company in a highly charged industry. But the sense of creativity and the drive for innovation was so evident as to be almost palpable. State of the art equipment was readily available and new facilities were being planned, in large measure to accommodate the array of new products being envisioned.

As important as the spirit of the company may be, the numbers also tell a story. In 1980, before the R&D tax credits were enacted, AMD devoted approximately 12.5 percent of sales to R&D activities. In 1981, the first year the credit was in effect, AMD increased its percentage for R&D to approximately 16.6 percent and by 1982, it had been raised to 20 percent.

In this same period, AMD has substantially increased the number of proprietary products it can offer—a fact directly attributable to the R&E credits. The increase in proprietary products has been a major factor in the record income of the company which in 1984 is more than triple that of the previous year.

AMD estimates that since the R&E tax credit has been in effect, they have reaped some $15 million in R&D tax incentives. However, AMD also estimates that they will pay an additional $30 million in new taxes as a result of profits made on their new, proprietary products. Therefore, in the case of AMD, the Government is spending $1 to get back $2 over a 2-year period. Moreover, due to the construction of the law, AMD will have to devote that many dollars plus some to continue being eligible for the credits.

Mr. Chairman, I recognize that AMD is an atypical company in many respects. In fact, according to Business Week, AMD ranked fifth among 800 top corporations in terms of percentage of sales spent on R&D. But AMD is a worthy example of an industry leader which clearly increased R&D expenditure and, as a result of the new credits, reaped an added return on that investment which benefited both the company and the U.S. Treasury.

I understand that not every company can prove conclusively that the R&D tax credit produced its intended result. But the credit is only 2 years old and R&D by its very definition is long-range and visionary. I would urge this committee to use existing evidence of the benefits attributed to the credit not as an end point in measuring its effectiveness, but as an indication of potential still to come.

Moreover, I would suggest that the R&D credits be fully incorporated into the permanent tax code so that companies will have a genuine long-range incentive to increase their R&D activities, without the chilling effect of the existing sunset clause.

Finally, Mr. Chairman, I would add that I am not unmindful of the dilemmas faced by the Ways and Means Committee. As Members of Congress, we are all faced with the prospect of answering to the American public for the ravaged economy that will reoccur if the budget deficit is not reduced.

I am not one who subscribes to the trickle down effect espoused by so many. Nor will I ever trade reductions in Medicare, food stamps, school lunch programs or the like to keep alive unwarranted tax advantages. But I believe that narrowly drawn, carefully crafted tax credits which are designed to ensure progress in our business sector do have a place in the tax code. And this, Mr. Chairman, is just such an appropriate tax policy.

Thank you very much.

Chairman RANGEL. Well, thank you, Mr. Mineta. And of course, the present law rules are anything except narrowly drawn. As a matter of fact, there is some evidence that fast food outfits are taking advantage of the credit, as well as hair stylists and fashion designers. Further, Treasury has no idea as to who is using the credit, for what purposes, because the only evidence we have to date relates to about 6 months of 1981.

Mr. MINETA. I believe it is important, because of those concerns, that there be a redrafting of the definition. And also, I think what is more important to me is that we not throw the baby out with the bath water because of the abuse by a few.

Chairman RANGEL. Well, it would be interesting to get back to your example, because one of the problems that the General Accounting Office, the Congressional Budget Office, but not necessarily the Treasury, must assume that all of the statements made by the taxpayers are accurate and true when they prepare analyses of the use of the credit. The truth of the matter is that a lot of people don't know whether there has been some creative bookkeeping in order to make certain that what a broad range of expenses relating to research and development is now characterized as such in order to take advantage of a credit.

Mr. MINETA. To the same degree, Mr. Chairman, I think we also have to look at the other side of the ledger. And that is, how much R&D money has not been invested because of the temporary nature and the sunset provisions of this tax credit.

So I think that can be—it seems to me is just as nebulous in terms of what we maybe lose in not having investments being made in terms of R&D.

Chairman RANGEL. Well, you are going to have to wrestle with us on this because we are talking about some $7 billion revenue shortfall between now and 1989. There is no question we have to be competitive and that firms, such as the ones that are located in your district do need that added incentive if we are going to be able to increase our exports.

So your objectives are in line with what most Americans and certainly the committee people want to reach. However, we have to find some way to do it without abuse. We thank you for your testimony particularly since it focuses on the type of industries that are new, innovative, and moving forward. This is really our hope for the future.

Mr. Duncan?

Mr. DUNCAN. Thank you, Mr. Chairman. I have no particular questions. I would like to thank our colleague for an excellent statement. His knowledge of this particular technology certainly can be of great help to us in formulating some legislation. And I agree with you that we need, industry needs, time to plan further in advance than they have now, just 2 years. They cannot do it.

So I can certainly support you, and thank you for your help.

Mr. MINETA. Thank you very much, Mr. Duncan.

Chairman RANGEL. Mr. Pickle.

Mr. PICKLE. Well, we welcome our colleague here this morning. Mr. Mineta comes from a district where he has seen first hand the great importance and significance——

Mr. MINETA. Unfortunately, we are closing many companies from our area to your district, Mr. Pickle.

Mr. PICKLE. Yes.

Mr. **Mineta**. Might I also suggest that your nameplate be changed from Mr. Gibbons to Mr. Pickle.

Chairman **Rangel**. Thank you.

Mr. **Pickle**. I don't think Mr. Gibbons would object to me sitting——[Laughter.]

Mr. **Mineta**. I don't want anything going to his district. [Laughter.]

Mr. **Pickle**. But Mr. Mineta has seen the importance of this program to his district, and to many other districts including mine. And I agree with your statement that there is a very high correlation between research and development and international competitiveness.

That is the type of facts that we are trying to establish. So I appreciate your testimony very much.

Mr. **Mineta**. Thank you very much.

Chairman **Rangel**. You would be surprised how many of our colleagues who are strong supporters of the flat tax, have also come to support this credit.

Mr. **Mineta**. That is the next hearing, Mr. Chairman. Thank you very much.

Chairman **Rangel**. Thank you very much.

Congressman Ed Zschau.

STATEMENT OF HON. ED ZSCHAU, A REPRESENTATIVE IN CONGRESS FROM THE STATE OF CALIFORNIA

Mr. **Zschau**. Thank you very much, Mr. Chairman.

Chairman **Rangel**. Welcome.

Mr. **Zschau**. I want to commend you, Mr. Chairman and members of the subcommittee, for the outstanding array of witnesses that you have assembled for this investigation into the R&D tax credit. I think that they represent broad perspective and good experience that can shed enormous light on the subject.

I have the privilege along with my colleague, Congressman Norman Mineta, who just spoke, of representing an area in northern California known as Silicon Valley. At last count there were 700 high technology firms in my congressional district and there are others in his and the district of Congressman Don Edwards.

In addition, I am a product of that industry. For 13 years I was president of a computer manufacturing company, a company whose prospects in the eyes of most industry observers improved dramatically when I left to run for the House of Representatives.

I think that there are some fundamentals that we can all agree on. Some of these were mentioned by Congressman Mineta. First, technology, research and development are key to our international competitiveness, our productivity, improvements in our standard of living, and jobs. The benefits of research and development are unquestioned.

Second, I think we can agree on the fundamental that tax policy—not just R&D tax credits, but tax policy in the broadest sense—affects research and development. It affects the cost of capital. It affects funds that are available for R&D as well as other investments. It affects the risk return ratio on projects. Therefore, this committee must be concerned with the actions that it takes, not only with respect to this issue, but also other issues, on the impact of those actions on research and development.

Third—and this was mentioned in the dialog just completed—we are in intense competition with other countries. Our trade deficit is projected to be this year over $100 billion. In years past we used to look with some satisfaction at the electronics products sector of our trade transactions and say, "Well, at least in electronics we have a trade surplus."

Mr. Chairman, that is no longer true. Our trade surplus in electronics products has deterioriated. In 1978 it was about $12 billion, in 1980, $7.4 billion. Last year $1.5 billion. This year I predict that for the first time in history we will have a negative trade balance—that is, a trade deficit—in electronics products, the area that we used to point to with a great deal of satisfaction.

The implication of that is that when we are analyzing our tax policies and their impact on research and development, the analysis should be made in comparison to the tax policies in other countries. What are the other countries doing? What is their cost of capital?

What are their R&D tax policies? What are their financial incentives? Rather than just looking at our tax policy in isolation, we have to look at it in comparison to the other countries. I think what we will find is that it is appropriate for us to focus tax policy incentives on R&D and also on R&D relative to what is happening in other countries.

I might point out, as will be pointed out in more detail later this morning, that Japan, for example, has an R&D tax credit, much like the one that we have had in effect. France has an R&D tax credit, much like the one we have in effect. These are some of the considerations to keep in mind.

I have reviewed the testimony that was presented yesterday and that will be presented today, on the issue of what has been the impact of the R&D tax credit so far since it has been implemented in 1981. I would conclude that it is too early to say for sure. The data is sketchy, particularly the emperical data. But in spite of the fact that the tax credit has been only partially phased in years past, that it wasn't at the outset fully understood by all of the corporations, and that it was only temporary rather than a permanent project, I think that it is informative to see that the R&D spending during this last recession, 1982, 1983, was up.

R&D spending during those years was up. That is in contrast to our experience in other post war recessions where R&D spending in this country has gone down as the recession has taken place. So even though the evidence is not conclusive, at least there are indications that something different happened in this last recession compared to previous recessions.

The R&D tax credit may have been one of those things that was different and that had positive effective. You have received testimony from academic experts who have indicated that they think there is little or no or perhaps even a negative effect of the R&D tax credit. I would just point out in response to those suggestions that their analyses are theoretical in terms of the motivational aspects of the tax credit, and that the emperical data was based upon 1981 returns. Keep in mind that the tax bill was just passed in

1981. I would have been quite surprised if the R&D tax credit had any effect in the year in which it was passed. I think that we have to look to 1982–83 and this year in order to get a better idea emperically of the impact of the tax credit.

I would suggest to you that you will have before you in panels yet to come this morning, people who make R&D decisions in their companies. Two of my constituents—John Young, the president of Hewlett-Packard Co., and James Taylor at Varian Corp.—are the sort of people who make the R&D decisions. They are able to provide insight into the motivational impacts of the tax credit better than people in the academic community.

You have two questions before you, Mr. Chairman. The first is: Should we have a R&D tax credit at all. I think that we should. The task force that I chair, the Republican Task Force on High Technology Initiatives in the House, has endorsed the R&D tax credit. I think that we should have it, particularly since firms in foreign countries enjoy those kinds of tax benefits.

But the second question is: Should it be better? Should it be better than the tax credit as currently written into law? I think that that answer also is, yes, there as well. You are absolutely right: The definition of R&D was too loose in the original tax credit. It allowed expenditures that are really not research and development, technology, productivity related, to be included.

Also it should be more focused on true qualified research and development. I believe it should be made permanent so that it can provide a motivational impact for long term planning. I don't believe it should have caps on it. The more growth in research and development the better, rather than capping it at the hundred percent level.

I think in addition it should be extended and deepened for corporate contributions to university research. The reason I say that is as follows. When a company does research and development it gets the research result. When a company contributes research dollars to a university, it gets the research result, but it also helps to educate new engineers and scientists, the graduate students, the teaching assistants and so forth. That way we are getting more seed corn as well as harvesting the crop. And I think that is important that the phenomenon take place.

As far as its incremental nature and the base period problems, that's an issue that I think is going to take a lot of analysis. Some of the testimony you will be hearing today will deal with those issues.

In summary, let me just conclude by saying, we need more R&D in this country. We need more innovation. That is what is going to make us competitive and preserve and enhance job opportunities in this country. Tax policy is important in order to influence that outcome, but we need to analyze our tax policy in comparison to foreign countries' tax policies and financial incentives, as well as just within our own scope.

There are indications that the R&D tax credit works, but I believe it can be made better by focusing it, making it permanent, and enhancing it for contributions to university research.

I appreciate the opportunity to share these observations and thoughts with you, Mr. Chairman, and members of the committee. I would be delighted to answer any questions that you might have.

Chairman RANGEL. I want to thank you for your contribution. Staff advises me that you head up a task force in the area of advanced technology. I hope that you might be able to share some of your findings with us, especially as they relate to some of the things that you have testified about today. The record will remain open until September 17 for that purpose.

One of the questions would relate to the fact that the evidence about the impact of the credit is rather scanty on which to base a conclusion. Basically, we were only dealing with information from 6 months of 1981. Because, while you can't say that it had a negative effect, there has been very little evidence to show that it indeed had a positive effect.

There is strong evidence that there has been increases in R&D spending, but of course we don't know to what extent the increase is due to where differences in accounting procedures, or where R&D spending would have taken place anyway. Certainly, we are in full accord with you that the type of industries that you represent are not the type that have lent themselves to abuse, and indeed are very competitive industries. We are concerned in this country that such firms maintain that competitive edge.

If we are going to seriously consider the impact of the credit and doing something about the deficit, then we have to tell the taxpayers that we intend to target the credit in order to help our industries compete with other countries. We just can't say that having the credit available can't hurt. It costs $7 billion and we don't know all the facts.

Also we can't say let us make it permanent so we will get a better record. You referred several times to the way other countries treat research and development costs. And of course in addition to these tax credits, we do have in our own tax system a variety of R&D related deductions, such as expensing, rapid depreciation, the investment tax credit and any number of things.

I just don't know whether other countries just throw the credit out there and say, be creative, be inventive, and you can deduct it. If you could share with us the amounts of incentives that are given by other countries to industries, that would be very helpful in our deliberations.

Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman.

I want to thank our colleague, and ask, where in the experimentation/development/production chain of events should the credit end, if it should?

Mr. ZSCHAU. My feeling is that at the point in time when a product is developed and in production, the tax credit should no longer apply. There is a gray area when it is going into production, and the reason why I say that is that there are some technologies that are production technologies. That is, the method of producing is the unique capability, the product of the research, what provides the competitive advantage. I would hate to have the tax credit not apply to those kinds of breakthroughs that make us competitive.

Once the product is designed and tested, and once the new types of production technology are developed, the R&D phase is over and the implementation phase and the application phase begins. It is very difficult to draw a hard line. There are accounting rules that have already been defined which I would suggest we could use as a basis.

Mr. **DUNCAN.** As you can imagine, one of the most important and complicated issues that we have is to really define the types of expenditures that should be eligible for the credit. So if the committee chose to draft the narrowest possible definition of eligible R&E expenditures, what type of activity should be included, basic research or experimental activities, high tech, small business, or any other you might add?

Mr. **ZSCHAU.** Well, there is one area in the current tax credit that has been a gray area, which I think has been treated badly by the Treasury regulations. That is the area of software; the code, the instructions that a computer uses. In the old days the computer industry was primarily a hardware industry—producing things you could feel and touch and see. Increasingly, the computer systems business has had a heavier and heavier content of software in it. That in many instances is what makes the technological breakthroughs happen. Artificial intelligence software is one example.

Accordingly, I think it is important in the definition of the R&D tax credit to make sure that it applies to software development as well as hardware development.

In response to a comment that the chairman made about other countries—what is going on in other countries—there are some witnesses who you will hear this morning who will have specific comparisons to other countries that I think are very important. But let me just reemphasize, Mr. Chairman, that it is important that our companies play on a level playing field with our competitors. In absence of specific information of the impact of this tax credit, one might make the argument that if the tax policies of other countries are creating advantages for them, it would behoove us to at least consider seriously trying to equalize the competition. That in itself would be a justification for a tax credit here.

I would also point out, and this will be reemphasized by other witnesses following me, that the high technology companies in this country pay a higher effective tax rate than the average company. They don't have the kinds of capital equipment generally that get ITC consideration and so forth. They don't have equipment that gets the accelerated depreciation.

This means that the very companies that we are looking to for our innovative future are paying a higher tax rate than those in the more traditional industries. The R&D tax credit is one way of making up for that higher tax rate.

Chairman **RANGEL.** I am impressed with that observation because, as you know, less and less corporations are paying taxes. And some are now talking about refundable tax credits because they don't pay any taxes at all. I was also impressed with Congressman Mineta's argument that, for the investment we make in research, and the revenues that are raised as a result, you know, compensate for us taking a gamble with our own American talent.

So I hope some of the people that testify today don't embarrass you and say they are not paying taxes.

Thank you so much. Be certain to share with the committee the findings that you have from your task force. And we look forward to continuously working with you because we are proud of the production and productivity that is occurring in your area of our country.

Mr. ZSCHAU. Thank you very much, Mr. Chairman.

[The following was subsequently received for the record:]

Targeting the Process of Innovation

An Agenda For U.S. Technological Leadership And Industrial Competitiveness

Recommendations Prepared By:
The Steering Committee of
The Task Force On High Technology Initiatives
House Republican Research Committee
U.S. House of Representatives
First Edition, May 1984

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Executive Summary

America's challenge today and for the future is to create enough new and satisfying jobs to employ our growing work force and to increase the standard of living for all Americans. The key to meeting this challenge is industrial competitiveness—developing and producing products and services whose quality and prices make them attractive to consumers abroad and those here at home.

Under President Reagan's leadership, the United States today is experiencing strong, broad-based economic growth. Nevertheless, some American industries have lost their competitive edge. U.S. firms have been beaten out in foreign markets, and they have lost market share here at home. This has cost American jobs.

Some suggest that this is a permanent condition. They say that America should "write off" industries that have lost ground and concentrate solely on new "sunrise" industries.

We disagree. We believe America can improve its competitiveness in those traditional industries that still have growth potential worldwide. However, to do so American industries will have to *exploit change* rather than fight it. U.S. firms will have to operate in new and better ways. They will have to offer improved products and services. They will have to find techniques to increase worker productivity and product quality. In short, American industries must apply far more technology and innovation, and they must improve the utilization of manpower.

U.S. leadership in technology and its applications has been a primary source of increased competitiveness and new jobs in the past. We must preserve our leadership. But the creation of new technologies and innovation can't be *forced.* Creative ideas, improved products, new companies, and revitalized factories don't spring from government "targeting" of technologies or industries. Rather, they are the product of individuals with vision, genius, and the courage to take risks. As such, innovation can only be *fostered* by an economic environment that encourages individuals and growth.

We believe that the proper role of government in promoting U.S. technological leadership and industrial competitiveness is to *"target" the process* by which new ideas and products are developed—*the process of innovation.* That is, our government should focus on creating an environment in this country in which innovation, new ideas, and new companies are likely to flourish and in which firms in mature industries can modernize. Making sure that such an environment exists is the best way government can help America maintain its technological leadership and industrial competitiveness.

There are four conditions needed for an environment that promotes innovation:

- *A strong commitment to basic research,* deepening and broadening our understanding of fundamental processes that will form the basis for industries, processes, and products in the future;
- *Incentives for investors, entrepreneurs, and innovators* to provide the capital and take the personal risks associated with making technological advances, developing new products, establishing new companies, and rejuvenating mature industries;
- *A strong educational capability,* particularly in the sciences, that assures an ample quantity of trained technical and managerial personnel and a broad base of educated and well-trained citizens who can meet the challenges of a rapidly changing world;
- *Expanding market opportunities,* domestic as well as foreign, which require a healthy domestic economic environment and aggressive trade policies.

Proper government policy for industrial competitiveness is one that focuses on these prerequisites for innovation. It consists of specific legislative and regulatory initiatives that foster these conditions and avoids government actions that would weaken them. The specific initiatives needed will vary as actions are taken and events unfold, but there are specific actions that can and should be taken right now.

This Agenda for U.S. Technological Leadership and Industrial Competitiveness contains 14 legislative initiatives that we believe the 98th Congress should take in 1984 to strengthen the elements that are fundamental to the process of innovation. We have limited this first edition of the Agenda to specific proposals that can and should be implemented in 1984. All of the initiatives recommended in this Agenda are designed to improve the climate for innovation. We believe each is important and would make a meaningful difference. However, we believe one recommendation—reducing the enormous projected federal budget deficits—stands out above the others in its impact. The other proposals will only be fully effective in a healthy domestic economy which cannot survive continued deficit spending of the magnitude now projected.

BASIC RESEARCH
RECOMMENDATIONS FOR 1984

- Increase emphasis on civilian basic research as recommended in the President's FY85 budget;
- Offer a 25% tax credit for corporate funding of research in colleges and universities;
- Modify antitrust laws to require that R&D joint ventures be judged by their competitive effects only and reduce the potential liability for damages from treble to actual damages.

INCENTIVES FOR RISK TAKING
RECOMMENDATIONS FOR 1984

- Make permanent the R&D tax credit and make it applicable to software and start-up companies;
- Make permanent the moratorium on Treasury Regulation Section 861.8;
- Modify antitrust and intellectual property laws to require that the courts consider the effects of competition when judging alleged patent misuse by a patent holder and alleged antitrust violations in the licensing of intellectual property;
- Permit enforcement of a domestic process patent against a product made without proper authority in a foreign country by the patented process;
- Extend intellectual property law to include semiconductor designs and masks.

PROVIDING TRAINED PERSONNEL
RECOMMENDATIONS FOR 1984

- Offer tax credits and enhanced deductions to corporations contributing state-of-the-art scientific equipment and related support services to colleges and universities for educational purposes;
- Permit foreign nationals who possess critical skills which are in short supply in the U.S. to remain and work here.

EXPANDING MARKET OPPORTUNITIES
RECOMMENDATIONS FOR 1984

- Create a new export incentive to replace the Domestic International Sales Corporation (DISC) that the U.S. has agreed to discontinue;
- Instruct our trade negotiators to seek elimination of trade barriers and extension of the GATT to cover investments and services;
- Focus and streamline export controls so they are more effective in preventing the trade-related transfer of militarily critical technologies to our adversaries while avoiding unnecessary obstacles to exports;
- Take actions to reduce substantially the projected budget deficits for FY1985 and beyond.

Enhancing U.S. Technological Leadership and Industrial Competitiveness

America's Challenge: Jobs and Prosperity

America's challenge today and for the future is to create enough new and satisfying jobs to employ our growing work force and to increase the standard of living for all Americans. The key to meeting this challenge is industrial competitiveness—developing and producing products and services whose quality and prices made them attractive to consumers abroad and those here at home.

Under President Reagan's leadership, the United States today is experiencing strong, broad-based economic growth. Nevertheless, some American industries have lost their competitive edge. U.S. firms have been beaten out in foreign markets, and they have lost market share here at home. This has cost American jobs.

Some suggest that this is a permanent condition. They say that America should "write off" industries that have lost ground and concentrate solely on new "sunrise" industries.

We disagree. We believe America can improve its competitiveness in those traditional industries that still have growth potential worldwide. However, to do so American industries will have to *exploit change* rather than fight it. U.S. firms will have to operate in new and better ways. They will have to offer improved products and services. They will have to find techniques to increase worker productivity and product quality. In short, American industries must apply far more technology and innovation, and they must improve the utilization of manpower.

U.S. Technological Leadership Has Helped Create Jobs

Over the past several years, a variety of studies have documented the importance of technological innovation to our economic growth, productivity, job opportunities, and trade competitiveness. A study by the Massachusetts Institute of Technology estimated that 80 percent of the growth in the gross national product of the United States between 1909 and 1949 was due to technological change(1). Further, a recent Commerce Department study found that during the 1970's, the productivity growth rate in high technology industries was more than six times the average of U.S. business. During the same period, employment in high technology and support industries grew more than 50% faster than the growth in total U.S. employment(2).

In recent years, while the overall export performance of the United States has not been good, exports of technology-intensive products have shown excellent growth. From 1970 to 1980, these industries increased their export surplus from $10.4 billion to $42.4 billion per year. During the same period, the trade balance of industries without technological bases declined from near zero to a negative $21.5 billion per year(3). Since each $1 billion of exports results in about 25,000 jobs for Americans, it is clear that American technological leadership in the past has enabled the United States to create many new jobs(4).

U.S. Technological Leadership is Being Challenged From Abroad

On January 25, 1983, President Reagan in his State of the Union message announced that "This Administration is committed to keeping America the technological leader of the world now and into the 21st century." This commitment by the President to spur technology may have come just in the nick of time. U.S. technological leadership has lost momentum in recent years. It hasn't been squandered like some other resources through overuse and waste. It's been frittered away through neglect.

During the 1970's, research and development (R&D) expenditures as a percent of gross national product (GNP) declined about 10% in the United States, reaching a low in 1977-78 of 2.23%. At the same time, our two most aggressive trading partners—Japan and West Germany—increased their R&D expenditures as a fraction of GNP by 20% and 21% respectively. Fortunately, the U.S. trend has reversed since 1978, and in 1983, R&D as a fraction of GNP is estimated at 2.65%—about equal to Japan and West Germany. However, since the U.S. conducts much more defense-related R&D than the other two nations, figures for *civilian* R&D are presently about 30% higher for Japan and West Germany(5).

The lower intensity of our research efforts in the 1970's appears to have contributed to a decline in our leadership in contributions to engineering and scientific advances. Domestic patenting by U.S. inventors declined by 24 percent during the period 1972-81, while U.S. patents to foreign inventors increased(6). U.S. market share of technology-intensive products also fell, from 23.1% in 1970 to 19.9% in 1980(7).

Central Planning Isn't the Answer

Due to the outstanding performance of the U.S. high technology industries plus the growing recognition that U.S. leadership in technology and its applications are being threatened from abroad, high technology and industrial competitiveness issues have been receiving considerable attention in Congress recently.

This is good, but in its enthusiasm to help, Congress must avoid the temptation of promoting direct government involvement of targeting "winners" and "losers" in American industry. The dismal results of the British experiment in central planning and the recent U.S. experience in government "assistance" to synthetic fuels, for example, should illustrate the fallacy of that approach. Still, the House Banking Committee recently passed a bill which proposes forming a Council for Industrial Competitiveness and an associated Bank for Industrial Competitiveness. These new agencies would be charged with formulating a "broad industrial strategy" by providing billions of dollars in federal funds to targeted companies(8).

We believe such a scheme would be doomed to failure. Bureaucrats in Washington, D.C. should not be given the job of picking between opportunities and dead ends. Making such decisions is hard enough for investors or managers in the private sector who are on the firing line and have much to gain or lose personally from the results. Besides, politics would undoubtedly play a major role in the decisions of the Bank and Council. The history of federal handouts indicates that the money is often given to the industries and regions who are best represented in Washington rather than on the basis of merit. A similar conclusion was reached by the Joint Economic Committee after extensive hearings were held on industrial policy last year.(9)

A recent Price-Waterhouse survey of over 400 companies—mostly small and mid-sized firms—showed that business people understand the folly of such government intervention. Less than five percent of those surveyed supported the approach of government finance banks or industrial targeting(10).

Government Should Target the Process of Innovation

The federal government can play a role in promoting U.S. technological leadership and industrial competitiveness, but we believe it should be a "targeting" of a different kind. Rather than targeting specific technologies or industries, the proper role of government is to *target the process* by which the new ideas and products are developed—the *process of innovation*. That is, our government should focus on creating an environment in this country in which innovation, new ideas, and new companies are likely to flourish and in which firms in mature industries can modernize. Fostering such an environment is the best way government can help America maintain its technological leadership and industrial competitiveness.

There are four conditions needed for an environment that promotes innovation:

- *A strong commitment to basic research*, deepening and broadening our understanding of fundamental processes that will form the basis for industries, processes, and products in the future;
- *Incentives for investors, entrepreneurs, and innovators* to provide the capital and take the personal risks associated with making technological advances, developing new products, establishing new companies, and rejuvenating mature industries;
- *A strong educational capability*, particularly in the sciences, that assures an ample quantity of trained technical and managerial personnel and a broad base of educated and well-trained citizens who can meet the challenges of a rapidly changing world;
- *Expanding market opportunities*, domestic as well as foreign, which require a healthy domestic economic environment and aggressive trade policies.

Proper government policy for industrial competitiveness is one that focuses on these prerequisites for innovation. It consists of specific legislative and regulatory initiatives that foster these conditions and avoids government actions that would weaken them. The specific initiatives needed will vary as actions are taken and events unfold, but there are specific actions that can and should be taken right now.

An Agenda for 1984

The following Agenda for U.S. Technological Leadership and Industrial Competitiveness contains 14 legislative initiatives that we believe the 98th Congress should take in 1984 to strengthen the elements that are fundamental to the process of innovation. We have limited this first edition of the Agenda to specific proposals that we think can be implemented in 1984. As such, it does not address many other important factors affecting innovation including K-12 education, worker training, employee incentives, cost of capital, and technology commercialization. Recommendations on these and other factors will be offered in future editions of this Agenda.

A STRONG COMMITMENT TO BASIC RESEARCH

America must renew its commitment to basic research. The federal government must continue to increase its funding of research carried out in universities and research laboratories. The truly basic research—such as the study of DNA that eventually resulted in gene splicing technology which spawned the genetic engineering industry—will normally not be pursued by the private sector because it is not related closely enough to specific products. Funding such research is a proper role of government. Federally funded basic research performed in America's colleges and universities also helps to train the scientists and engineers needed for teaching and future research.

We support the Administration's increased emphasis on civilian basic research in the FY85 research and development budget recommendations, and the stepped-up commitment to integrating the resulting new knowledge into the private sector.

We also believe that closer relationships between research universities and American industry should be encouraged. Closer ties would better expose researchers to the problems and opportunities that American firms face and might result in speedier application of research results to practical situations.

One way to foster better university relationships is to encourage greater corporate financial support of university research. Legislation offering a new 25% tax credit for corporate funding of research in universities and other non-profit institutions would do that. It would also reduce the enormous dependency that universities have today on federal funding of basic research.

In addition to funding basic research, Congress should clarify U.S. antitrust laws so they provide appropriate ground rules for the U.S. economy in the international marketplace now and in the future.

In the United States today, there are companies that want to engage in joint research and development ventures. Such ventures would enable the companies to pool their scarce research resources to pursue very risky or expensive projects and share in the results that are produced.

Currently, any such joint venture could be ruled a *per se* violation of antitrust law and would be subject to treble damages. The risk of antitrust suits—even when the R&D joint venture would increase U.S. competitiveness—prevents companies in the United States from pursuing important R&D projects.

Antitrust laws should be modified so that R&D joint ventures would be judged by their effects on competition as defined by case law or by legislative guidelines. Also, the potential liability for damages in such cases should be reduced from treble to single (actual) damages.

Taking unnecessary legal risks out of the formation of R&D joint ventures would permit U.S. high technology companies to undertake R&D projects that would be too risky or too expensive for a single company to pursue alone. It would also enable companies to compete more effectively against the consortiums that have long been encouraged in other countries. In addition, lessening the antitrust risk would enable the ailing companies in the so-called "smokestack" industries to work together to solve their common problems and become more competitive in world markets.

BASIC RESEARCH
RECOMMENDATIONS FOR 1984

- Increase emphasis on civilian basic research as recommended in the President's FY85 budget;
- Offer a 25% tax credit for corporate funding of research in colleges and universities;
- Modify antitrust laws to require R&D joint ventures be judged by their competitive effects only and reduce the potential liability for damages from treble to actual damages.

INCENTIVES FOR THE RISK TAKERS

In addition to basic research, the U.S. needs more incentives for the risk takers—the investors, entrepreneurs, inventors, and enterprises who must take the risks of pursuing new ideas. Here, tax policy and regulatory policy play a significant role.

Tax Policy

The reduction of the capital gains tax rate, passed by Congress in 1978, illustrates the enormous impact that tax policy can have on the availability of risk capital for the financing of new ventures. In 1978, the maximum tax rate on capital gains was reduced from nearly 50 percent to 28 percent. During the eight years prior to 1978, less than $50 million in new capital was made available each year to venture capital funds investing in small companies. However, within eighteen months after the capital gains tax was reduced, $1 billion in new capital was made available to such funds. The maximum capital gains rate was lowered again in 1981 to 20 percent, and in 1983, $4.1 billion of new venture capital was made available from investors(11).

In addition to incentives for investors, the U.S. needs improved incentives for corporate risk taking. The Economic Recovery Tax Act of 1981 contained such an incentive—a 25 percent tax credit on *increases* in research and development expenditures.

This tax credit was an excellent idea. It appears already to have had a positive effect on research and development expenditures. Although the R&D credit was only partially phased-in during 1981 and 1982, a recent McGraw-Hill survey showed that despite the severe recession during that period, there was a significant increase in R&D spending during those years, making it the first post-war recession in which the pace of research spending did not decline(12).

The R&D tax credit can be an important incentive for innovation in all industries, but the restrictions that were placed on the credit by Congress and the Treasury Department have hampered its effectiveness. They have limited the credit's applicability for start-up companies and computer software, and, most importantly, the tax credit is only temporary. It expires on December 31, 1985. However, since most R&D projects are long-term in nature, a temporary R&D tax credit may not provide an adequate incentive for such projects. Congress should pass legislation this year to refine the applicability of the R&D credit and make it permanent so that companies can be assured of the credit's scope and availability when planning long-range projects.

Also, Congress should make permanent the current moratorium on the research and development portions of Section 861 of the tax code. Section 861.8 requires U.S. firms with overseas operations to allocate a percentage of their U.S. R&D expenditures against their foreign source income. This allocation, which denies U.S. firms the full tax benefits of conducting R&D in the United States, has caused U.S. multinational firms to perform more R&D abroad. Making the moratorium on Section 861.8 permanent would keep more R&D jobs here in the U.S.

Improved mechanisms are needed to attract capital to companies that have not been profitable in recent years but which could regain their competitiveness through retooling and modernization. The investment tax credit was enacted more than twenty years ago as an incentive to invest in new capital equipment. Unfortunately, it has not been effective for some of the companies that need it most. Although some companies have made large investments in capital equipment, they often have not earned sufficient profits to use all their tax credits against their liability. This increases their after-tax cost of capital and places them at a competitive disadvantage, particularly against competitors in countries where the cost of capital is lower. The Task Force will hold hearings on the capital formation problems of the ailing industries with the intent of proposing specific actions later this year to address the problems.

Patents and Copyrights

In addition to tax incentives, patent and copyright laws need to be strengthened to insure that innovators—both private and corporate—can receive fair rewards for their ingenuity. Often, the most efficient way to bring a new technology to market is by licensing that technology to others. Licensing can enable intellectual property owners to employ the capability of established enterprises to market a technology quickly and at lower cost. This can be particularly important for some small businesses that do not have the ability to develop all possible applications of new technologies by themselves.

Unfortunately, the courts have not always been sympathetic to the pro-competitive benefits of licensing. They have ruled against patent holders based on the form of their license agreements rather than their effects on competition. We believe innovation can be encouraged by modifying the antitrust and intellectual property laws to require that the effects on competition be considered by courts in cases involving the alleged misuse of a patent or copyright or involving antitrust charges stemming from intellectual property licensing.

We also recommend strengthening the protection of U.S. process patent holders by authorizing enforcement of a U.S. process patent against a product made without proper authority in a foreign country by the patented process. This is necessary because today foreign companies can use U.S. process patents abroad without authorization and then sell the resulting products in the United States with impunity.

Semiconductor circuit designs need protection from "pirate" firms—mostly overseas—which copy "chips" designed by U.S. firms. These chips have become pervasive in a wide variety of products such as automobiles, home appliances, and toys. "Pirate" firms, which don't spend money on R&D, can sell their copied products for much less than the companies that designed the products. This practice reduces the incentive for innovative companies to risk the millions of R&D dollars required for new semiconductor circuit designs. Protecting semiconductor circuit designs under intellectual property law would help innovative firms receive a fair return on their investments.

Federal Regulations

A significant portion of capital expenditures by the private sector is diverted from productive investment by regulations and government-induced delays. While many of these regulations are beneficial and necessary, they can be improved to accomplish their objectives without stifling innovation and productive investment. We support the increased use of cost-benefit analysis, risk analysis, incentive-based regulation, scientific data, and performance standards in regulatory policy and practice. In the future, we plan to offer specific proposals on reducing the regulatory drag on technological advances and industrial competitiveness.

INCENTIVES FOR RISK TAKING
RECOMMENDATIONS FOR 1984

- Make permanent the R&D tax credit and make it applicable to software and start-up companies;
- Make permanent the moratorium on Treasury Regulation Section 861.8;
- Modify antitrust and intellectual property laws to require that the courts consider the effects of competition when judging alleged patent misuses by a patent holder and alleged antitrust violations in the licensing of intellectual property;
- Permit enforcement of a domestic process patent against a product made without proper authority in a foreign country by the patented process;
- Extend intellectual property law to include semiconductor designs and masks.

AN ADEQUATE SUPPLY OF TRAINED PERSONNEL

The American educational systems should provide an adequate supply of trained people—particularly technically trained personnel. However, the future demand for engineers, scientists, and technicians is predicted to outstrip the supply. This could put the U.S. at a severe competitive disadvantage in world markets. Japan, for example, with half the population of the U.S., is training about the same number of bachelor-level engineers per year as the United States. An American Electronics Association (AEA) survey predicts that there may be a shortage of about 16,000 new electrical engineers and computer scientists per year for the next few years(13).

Although there are improvements needed at all levels of our educational system—pre-college, college, vocational, continuing, and worker retraining—we believe the most critical education roadblock to innovation today stems from a lack of capacity in our university science and engineering departments. This is due to the high cost of educating technical people. Universities struggle to attract enough qualified professors because industrial salaries are so attractive. As a result, there are currently some 1400 unfilled faculty openings in U.S. engineering schools(14). Sadly, 67 percent of the engineering student applicants are turned away(15). Also, most schools can't afford to buy all the up-to-date equipment needed to train engineers and scientists.

Private industry has an important role to play in funding technical education programs. The AEA and the Massachusetts

High Technology Council, for example, have already established industrial giving programs to collect money from corporations for faculty salaries and equipment.

The federal government has a role to play, too. Tax credits and enhanced deductions for corporate contributions of state-of-the-art equipment and support services for educational purposes should be offered. Such incentives would encourage more private sector support for increasing the capacity of our technical education facilities without requiring a new federal bureaucracy to carry it out.

U.S. immigration policy should also recognize the need for trained technical people. In particular, a high percentage—30% to 50%—of graduate engineering students are foreign nationals. Students who develop technical skills that are in short supply in this country should be permitted to remain here. Immigration reform legislation should continue to permit technically trained foreign nationals to remain in this country to contribute to U.S. technology rather than requiring such students to return to their home countries after receiving their education in the U.S.

We recognize and are concerned about the plight of workers who are unprepared for the changes and new jobs that will be created by advances in technology. The Job Training Partnership Act, which went fully into effect on October 1, 1983, was designed to address this problem. We will be evaluating its effectiveness and will report on its performance as well as suggesting improvements and other job training initiatives in future editions of this Agenda.

PROVIDING TRAINED PERSONNEL
RECOMMENDATIONS FOR 1984

- Offer tax credits and enhanced deductions to corporations contributing state-of-the-art scientific equipment and related support services to colleges and universities for educational purposes;
- Permit foreign nationals who possess critical skills which are in short supply in the U.S. to remain and work here.

EXPANDING MARKET OPPORTUNITIES

Even if the United States has a strong research base, incentives for risk-taking, and well-trained people, innovation and the creation of new jobs will be stifled unless there are attractive business opportunities at home and abroad. That means America must have a strong domestic economy, and U.S. businesses must have access to foreign markets. Government can play an important role in fostering both.

The United States should vigorously pursue a trade policy aimed at achieving free and *fair* trade. The U.S. should negotiate in a tough-minded fashion to break down the trade barriers erected by our trading partners so that American companies can compete on a level, two-way street.

In working to remove trade barriers, we should strive to strengthen the General Agreement on Tariffs and Trade (GATT), the multilateral organization which has done so much in the past to liberalize trade among the nations of the world. In addition, the role of the GATT should be expanded to cover services and investments—two areas of growing importance in today's world. Negotiating with our trading partners to modify the GATT to provide coverage of services and investments would help to improve our balance of payments and protect U.S. investors from damaging interference by foreign governments.

In addition to negotiating for a fair trading environment, government policy should encourage exports by U.S. firms, particularly small businesses. Tax incentives (like the Domestic International Sales Corporation which permit the deferral of taxes on profits from export sales) should be provided to encourage and help finance exports.

Export controls on high technology products should be focused and streamlined to prevent the trade-related transfer of militarily critical technologies to our adversaries while, at the same time, making exporting easier for U.S. companies. Likewise, restrictions on exports to achieve foreign policy goals should be implemented only after carefully considering existing contracts and determining whether they can be effective in light of the availability of the products from foreign sources.

Most importantly, U.S. businesses can achieve their full potential to create jobs if they operate within a healthy domestic economic climate. People are less willing to invest, make long-term business commitments, and borrow the funds needed for expansion when there is uncertainty about the direction of interest rates and inflation.

Congress and the Administration should act with a sense of urgency to reduce significantly the enormous projected budget deficits which are a source of economic uncertainty and distort international exchange rates in a way that damages U.S. export opportunities. We believe reducing the deficits requires a monetary policy that accommodates economic growth, a tax policy that encourages savings and investment, and the discipline to curtail the growth of spending. Only then can innovation flourish, mature industries be rejuvenated, and prosperity be sustained.

EXPANDING MARKET OPPORTUNITIES
RECOMMENDATIONS FOR 1984

- Create a new export incentive to replace the Domestic International Sales Corporation (DISC), which the U.S. has agreed to discontinue;
- Instruct our trade negotiators to seek elimination of trade barriers and extension of the GATT to cover investments and services;
- Focus and streamline export controls so they are effective in preventing the trade-related transfer of militarily critical technologies to our adversaries while eliminating unnecessary obstacles to exports;
- Take actions to reduce substantially the projected budget deficits for FY 1985 and beyond.

Conclusion

We have necessarily focused this Agenda on conditions we believe will foster innovation and maintain the U.S. leadership role in technology and industrial competitiveness. This will increase job opportunities and the standard of living for Americans. In addition, it must be emphasized that with a strong, vibrant industrial base, America can lead the quest of peoples throughout the world for increased standards of living, better education, improved health, and more productive jobs.

Technology and innovation are perhaps our nation's greatest strengths. They must be preserved. However, innovation cannot be *forced*. It can only be *fostered*. It is fostered by creating an environment that emphasizes freedom of scientific and industrial activities and that offers incentives to the innovators, entrepreneurs, and investors who have the talent and resources to advance and apply technology. It is fostered by a thorough understanding of fundamental scientific processes and by a population that is well-educated in science and its application. It is fostered in a healthy economic environment and by trade policies that provide expanding market opportunities for our technology and basic manufacturing companies. Promoting such an environment should be a primary policy objective of the United States.

It is to that goal that this Agenda for U.S. Technological Leadership and Industrial Competitiveness is dedicated.

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Footnotes

[1] *Review of Economics and Statistics,* August, 1957, Harvard University Press, Cambridge, Massachusetts.

[2] *An Assessment of U.S. Competitiveness in High Technology Industries,* U.S. Department of Commerce, International Trade Administration, February, 1983, pp. 4-5.

[3] *Ibid,* p. 43.

[4] Statement by Paul Volcker, Chairman, Federal Reserve Board, before the House Ways and Means Committee, U.S. Congress, Washington, D.C., April 10, 1984.

[5] *Science Indicators 1982,* National Science Board/National Science Foundation, 1983, pp. 195, 197.

[6] *Ibid,* p. 209.

[7] *An Assessment of U.S. Competitiveness in High Technology Industries,* U.S. Department of Commerce, International Trade Administration, February, 1983, p. 44.

[8] H.R. 4360, 98th Congress, Introduced by Rep. John LaFalce, November 10, 1983.

[9] *Industrial Policy: A Joint Economic Committee Staff Study,* U.S. Congress, April 1984.

[10] *Business Views on Competing in the High Technology Era: The Results of a Survey of High Technology Companies,* Price-Waterhouse, Washington, D.C., March, 1984.

[11] *Venture Capital Journal,* January, 1984, Venture Economics, Wellesley, Massachusetts, p. 6.

[12] *28th Annual McGraw-Hill Survey of Business' Plans for Research and Development, 1983-86,* McGraw-Hill Publications Company, New York, May, 1983.

[13] *Technical Employment Projections 1983-87,* American Electronics Association, Palo Alto, California, July, 1983.

[14] Geilse, John W., 'The Faculty Shortage: The 1982 Survey," *Engineering Education,* vol. 74, no. 1, October 1983, pp. 47-53.

[15] Statement by the Blue Ribbon Committee on Engineering Education, American Electronics Association, Palo Alto, California, June, 1981.

Chairman **Rangel**. Now, from the Commonwealth of Massachusetts, testifying on behalf of the Governor, the secretary of economic affairs, the Honorable Evelyn Murphy. She will be joined by Philip Shea, State senator from the Massachusetts State Senate.

STATEMENT OF HON. EVELYN F. MURPHY, SECRETARY OF ECONOMIC AFFAIRS, COMMONWEALTH OF MASSACHUSETTS, ON BEHALF OF HON. MICHAEL S. DUKAKIS, GOVERNOR

Ms. **Murphy**. Good morning.

Chairman **Rangel**. Good morning, Madam Secretary. Your full statement will appear in the record. You can highlight it or testify in a manner that makes you feel comfortable.

Ms. **Murphy**. Thank you, Mr. Chairman; it is a pleasure to be here. I thank you for the opportunity to come on behalf of Governor Dukakis and testify. He could not be here, so he asked me to represent him and convey to you the position of the Commonwealth of Massachusetts. Governor Michael Dukakis, who could not be here today, asked me to represent him and to convey to you the position of the Commonwealth on the issue of research and development tax credits.

The Governor believes, as I do, that when the Federal Government makes tax policy, it has a dramatic effect on a State's economic policy. We, in Massachusetts, have long witnessed the effects that Federal tax and spending policies can have on the local economy.

Let me explain. The first generation of high technology began in Massachusetts in a few university laboratories in the 1950's. A large portion of the work done in those labs was the result of direct Federal grants for research and development. And in many cases it was the students in those labs who later started small companies in back rooms and garages near Route 128 and who eventually triggered the high tech boom in Massachusetts in the 1970's and 1980's. Chief executive officers such as Ken Olsen of Digital Equipment Co., Dr. An Wang of Wang Labs, and John Cullinane of Cullinet Software, and their companies, were all products of those 1950's college labs. Today they are the leaders of Massachusetts companies and international leaders in high technology.

The reason why the High Technology and Scientific Education Act, H.R. 4475, is so important is that today our high technology industry functions in an international marketplace. Because high tech companies in other nations, such as Japan, receive government support in the form of subsidies, low-interest government loans, antitrust immunity and extensive government R&D assistance, our government should develop an overall economic policy that promotes high technology and, as Congressman Zschau said, so we can play on a level playing field.

Currently Federal policy does not favor high technology. For example, ongoing studies by Congress' Joint Committee on Taxation have shown that the effective tax rates of high technology electronics companies are 40 to 75 percent higher than the average U.S. corporation. On another front, it is a recognized fact internationally that U.S. high tech companies function under the tightest export licensing controls of any noncommunist nation. Both Governor Dukakis and I have been working with our high tech companies to change regulations that affect our ability to compete.

If the next generation of high technology is to be spawned in the United States, it must be a tripartite arrangement with industry, academia, and Government each doing its share as well as a coordinated Federal tax and economic policy. In Massachusetts we have developed the Centers of Excellence Program in which private industry, working with State government and universities, has already begun work in tomorrow's technology—polymer sciences, biotechnology, photovoltaics, and marine sciences.

Along with this testimony, I will submit a table of 26 Massachusetts high tech companies, which shows the dramatic increase in R&D expenditures over the period from 1980–83. In line, Mr. Chairman, with your earlier conversations, these data may suggest to you some of the trend we are seeing over that 4-year period. Clearly what we see right now is that something did happen during the recession to increase the amount of expenditures on R&D for these companies in Massachusetts.

What you can see there is that companies like Genrad, Inc., a leading equipment testing firm, is currently spending over 50 percent more of its sales income on research and development than it did in 1980. Digital Equipment Corp. is spending 167 percent of its net income on research and development, more than double what it spent in 1980. Wang Laboratories is also spending more than twice as much on research and development as it did in 1980 in real dollars.

Before closing, there are three points that I would like to make regarding the importance of a swift enactment of H.R. 4475.

First, research and development is a long-term investment process. If the research and development credit is to be an effective investment, companies must know that it will be available to them for a number of years into the future. If enactment of the credit is delayed until sometime in 1985, its incentive effect will be reduced and our own competitive edge weakened.

Second, in asking for this research and development tax credit to be made permanent, the high tech industry is not asking for a subsidy or protectionist legislation. It is asking for the extension of a currently existing performance-based incentive. The credit will only enhance the international competitiveness of a company that expends the resources on research and development which will allow it to qualify for the tax break.

Finally, even small start-up companies would be eligible for the credit under H.R. 4475. In our table you will notice that Stratus Computer, a start-up company that had no sales in 1980 and over $20 million in sales in 1983, currently spends 131 percent of its net income on research and development. Companies like Stratus are the future of high technology in America. We must give them a chance to compete against Japanese and West Germany companies.

In closing, I would like to point out that the secret to the success of the Japanese in the last few years has been the willingness of Government to collaborate with industry and academia. In Massachusetts our success has been fostered by such new arrangements as the centers of excellence, whereby Government and the private sector working with our colleges and universities have started to produce a very healthy economic climate.

Mr. Chairman, it would seem that if such a collaborative effort works in Japan and it works in Massachusetts, then it would work for the United States as well. The 198 research and development tax credit is a beginning in this collaborative effort, and it is working. Both Governor Dukakis and I strongly urge you to allow this good beginning to continue. We urge you to make the research and development tax credit permanent and do so as soon as possible.

Thank you very much.

[Attachment to the statement follows:]

Company	Sales		Total R&D experience		Percent change 1980–83	Percent R&D over sales		Percent R&D over net income	
	1983	1980	1983	1980		1983	1980	1983	1980
Hewlett-Packard Corp [1]	$4,710.0	$3,046.0	$493.0	$272.0	81	11	9	115	101
Digital Equipment Corp	4,271.9	2,368.0	472.4	186.4	153	11	8	167	74
Honeywell, Inc [2]	5,753.1	4,924.7	428.6	295.4	45	7	6	185	102
Motorola, Inc	4,328.0	3,283.6	336.0	200.0	67	8	7	138	104
Wang Laboratories	1,538.0	543.3	117.5	36.7	210	8	6	77	70
Data General Corp	828.9	653.9	84.7	65.6	29	10	10	366	119
Prime Computer, Inc	516.5	267.6	52.1	20.4	150	10	8	160	68
Computervision Corp	400.0	191.0	43.7	18.8	125	11	10	124	80
Foxboro Co	533.1	509.0	45.9	29.0	58	9	6	575	92
Genrad, Inc	226.6	157.6	31.2	14.2	106	14	9	159	129
Teradyne, Inc	251.4	164.9	30.6	20.3	50	12	12	142	180
GCA Corp	194.8	191.0	25.3	11.4	125	13	6	59	77
Millipore Corp	292.5	234.3	21.8	13.7	60	8	6	106	72
Analog Devices, Inc	214.0	135.6	19.6	9.1	115	9	7	106	97
EG&G, Inc [3]	904.0	631.9	12.9	10.4	23	1	1	27	40
Cullinet Software	78.6	17.7	10.5	2.0	425	13	11	91	83
Dynatech Corp	124.3	66.2	8.9	3.5	170	7	5	97	71
Unitrode Corp	131.1	81.6	6.5	1.8	260	5	2	47	20
Alpha Industries, Inc	52.2	25.3	4.5	1.7	163	9	7	87	81
Stratus Computer, Inc [4]	20.6	....	2.9	....	....	14	....	131	....
Adams-Russell Co	91.9	42.6	2.7	0.8	240	3	2	28	23
Bolt Beranek & Newman	85.4	46.9	2.0	1.4	48	2	3	60	48
Nuclear Metals, Inc	58.0	24.3	1.8	0.2	800	3	1	35	10
Ionics, Inc	54.2	44.5	1.8	2.1	−14	3	5	80	116
Sippican Ocean Systems	27.0	11.6	1.4	1.4	000	5	13	54	200
Dynamics Research Corp	44.0	27.3	1.1	1.4	−20	3	5	110	175

[1] Not represented on the High Tech Council Board of Directors.

[2] Not represented on the High Tech Council Board of Directors. Research figures do not include $348.5 million in customer-sponsored research in 1983 and $274.2 million in 1980.

[3] Research figures do not include $54 million in customer-sponsored research in 1983 and $58 million in 1980.

[4] Startup company that had no sales in 1980.

Source: Publicly held companies represented by the Massachusetts High Technology Council Board of Directors—used by permission.

Chairman RANGEL. Thank you, Madam Secretary. We may not have a problem with your observations except that this tax credit is much broader than anything you are talking about for the Commonwealth of Massachusetts. And of course the dramatic increase in productivity is the type of thing that we also could do by direct subsidy, which is not a bad word if, in fact, it is helping American businesses to be more competitive. It is good to see that your local and State governments are reaching out and having some type of partnership with businesses.

Do you give any type of preferential tax incentives to these businesses in the State tax system?

Ms. **Murphy**. We have looked at some preferential treatment for contributions of some of these high-tech equipment to our universities and colleges as further stimulus.

Chairman **Rangel**. Well, we do that. And of course they are included in our tax laws. But the reason I ask is I am confident that you would target those industries that are productive and the ones that you would want in your State. You wouldn't just do it across the board, because your testimony is very targeted. The examples you are using are very targeted.

Ms. **Murphy**. Yes.

Chairman **Rangel**. We don't have that clean focus to deal with here. We deal with $7 billion revenue less benefit taxpayers across the board. So if you could help us with your legislative abilities, or submit whatever drafts you already have in the executive office as to how you would target R&D subsidies if you decided to enact such legislation—this may be something the committee would want to look at.

Ms. **Murphy**. We would be glad to provide you with that information, Mr. Chairman, yes.

[Information not received at time of printing.]

Chairman **Rangel**. Mr. Duncan.

Mr. **Duncan**. I have no questions other than to thank you very much, Madam Secretary.

Ms. **Murphy**. Thank you very much.

Chairman **Rangel**. Senator, could we hear from you? Senator Shea.

STATEMENT OF HON. PHILIP L. SHEA, STATE SENATOR, COMMONWEALTH OF MASSACHUSETTS

Mr. **Shea**. Thank you, Mr. Chairman. I would like to preface my remarks by thanking you and other members of your committee in advance for being given the opportunity to come here this morning to indicate my support for the proposals introduced by Congressman Jim Shannon, not only to renew, but to make permanent and expand the research and development investment tax credit.

Mr. Chairman, from my viewpoint as a State Senator, the employment benefits of high technology industry are apparent.

In Massachusetts, Data General employs approximately 7,000 people, and Raytheon employs almost 29,000. In the Fifth Congressional District, in which total employment was 280,181, according to the Division of Employment Security's June 1984 estimate, Wang presently employs approximately 11,000; Digital employs approximately 9,200; and Raytheon employs nearly 18,000 people. The combined employment figures of just those four large high technology companies account for over 38,000 jobs, or nearly 14 percent of the employed population, in the Fifth Congressional District.

We need those jobs. The point I want to make today is that the R&D tax credit has had a lot to do with keeping high technology companies growing and creating those jobs. In 1980, before the tax credit was instituted, Wang spent only $36 million on R&D. By 1983, Wang was spending $117 million on R&D, more than a 200-percent increase.

Between 1980 and 1982, Data General also increased their spending on R&D from $65 million to approximately $84 million. That is an increase of approximately 30 percent.

Moreover, Digital reports increasing research spending, not only overall but as a percentage of sales, from 7.9 percent before the credit was instituted to 11 percent in 1983, or an increase of nearly 40 percent.

Finally, Raytheon has increased its spending on research and development as a percentage of sales from 2.9 percent in 1980 to 4.2 percent in 1983.

Thus far I have only been defending the value of the 1981 tax credit, rather than discussing Congressman Shannon's proposal to expand it. However, I must emphasize it is all important to make the credit permanent, rather than just extending it for 3 years, because of the long planning cycles of most high tech businesses.

I have spoken to many of the high technology companies in my district, and they all say the same thing: R&D will start to slow down now because the high technology industry cannot assume that the tax credit will exist past 1985. Extending the tax credit for another 3 years will not do the trick when you are talking about 3- to 5-year planning cycles for most companies.

That said, I would also like to add my support to Congressman Shannon's proposals to expand the credit.

These proposals to expand the credit will not only further encourage high technology industry to conduct research and grow, they will also help keep colleges and universities abreast of technological research by providing private industry with incentives to contract out their basic research. With more and more students and qualified engineers and technicians avoiding academic research because of outdated equipment and low pay, I do think it is important to foster better research conditions in our schools. Other proposals that would make it easier for corporations to donate their equipment to colleges and universities also have my support since I understand that companies often exchange equipment for basic research to be carried out by the schools.

Once again, I thank you all very much for this opportunity to speak on behalf of the research and development investment tax credit. I hope my testimony has increased this committee's understanding of the tax credit's benefits in a local setting.

[The prepared statement follows:]

STATEMENT OF HON. PHILIP L. SHEA, MASSACHUSETTS STATE SENATOR

I would like to thank Chairman Rangel and the distinguished members of this Committee in advance for the opportunity to indicate my support for the proposals introduced by Congressman Jim Shannon to renew, make permanent, and expend the Research and Development Investment Tax Credit.

The R&D tax credit has been very good for the Fifth Congressional District. The Fifth District, which includes the cities of Lowell and Lawrence, the town of Framingham, and 25 additional towns, is undergoing an important revitalization. Many high technology companies, such as Wang Laboratories, Inc., Digital Equipment Corporation, Data General Corporation, and Raytheon Company are growing and employing increasing number of people. In fact, in 1982 a study by the Joint Economic Committee reported that high technology industries accounted for 75% of the growth in jobs in the entire manufacturing sector from 1955 to 1979. Simultaneously, the Department of Labor predicted that five out of every six job categories that would grow during this decade would be in computer-related fields.

From my perspective as a State Senator, the employment benefits of high technology industry are apparent.

In Massachusetts, Data General employs approximately 7,000 people and Raytheon employs almost 29,000. In the Fifth Congressional District, in which total employment was 280,181 according to the Division of Employment Security's June 1984 estimate, Wang presently employs approximately 11,000 Digital employs 9,173, and Raytheon employs 17,841 people. The combined employment figures of just those four large high technology companies account for over 38,000 jobs or nearly 14% of the employed population in the Fifth Congressional District.

Speaking as someone close to the people, let me say: we need those jobs. The point I want to make today is that the R&D tax credit has had a lot to do with keeping high technology companies growing and creating those jobs.

I do not think I have to explain in great detail the correlation between the research and development of new or improved products and means of production, and the growth of an industry. Clearly, there are great opportunities for expansion and long-term growth when an industry starts branching out in different or more advanced directions.

Neither must I elaborate on the incentive the R&D tax credit gives high technology companies to increase research above maintenance-of-floor efforts. However, because opponents of a permanent tax credit have a very legitimate cause, that is, reducing the United States' huge budget deficit, at this time I would like to present some information from my own District that may help to convince them that the loss of revenue to the Federal government due to the tax credit (only $600 million in 1981) is well worth the investment in the long-term growth of the high technology industry. Here are the facts:

In 1980, before the R&D tax credit was instituted, Wang spent only $36.7 million on research and development. By 1983, Wang was spending $117.5 million on research and development, more than a 200% increase.

Between 1980 and 1982, Data General also increased their spending on research and development from $65,000,343 to $84,000,538. That is an increase of approximately 30%.

Moreover, Digital reports increasing research spending not only overall but as a percentage of sales from 7.9% before the credit was instituted to 11% in 1983, or an increase of nearly 40%.

Finally, Raytheon has increased its spending on research and development as a percentage of sales from 2.9% in 1980 to 4.2% in 1983.

These statistics document the incentive the R&D tax credit gives high technology industry to experiment and expand. What cannot yet be documented, because the tax credit is so new, is its long-term economic benefits. Nonetheless, we can expect with reasonable certainty that the tax credit will serve many important purposes, namely:

It will enable the United States to compete successfully in foreign markets with countries such as W. Germany and Japan;

And it will encourage high technology companies to conduct their research in the United States rather than allowing them to take advantage of better research investment conditions in foreign countries.

Previous to 1981, the United States was suffering from a frightening decline in R&D spending. From 1967 to 1977, aggregate R&D spending was down from 2.9% to 2.1% of the Gross National Product. From 1968 to 1975, R&D activities conducted by business, company-financed, and Federal expenditures declined from 2.01% to 1.58% of the real GNP. Moreover, American expenditures on civilian research were only 1.5% of the GNP as compared with 1.9% in Japan and 2.3% in W. Germany.

The comparison with foreign rates of spending on research is relevant to the discussion of the R&D Investment Tax Credit for two reasons.

First, in order for American companies to compete successfully with the high technology companies in Japan or W. Germany, they must continue to investigate faster, cheaper, and safer products and methods of production. Since the tax credit lessens the burden of the financial commitment that investigation requires, it directly improves the competitiveness of American companies in foreign markets.

Second, in order to keep American companies' investigatory research within American boundaries to minimize loss of revenue, jobs, and a reduction in GNP, the United States must provide incentives comparable to those in foreign countries for investment in research. Presently, this is not the case. For instance, today we are discussing the future of an R&D tax credit that is only three years old. Meanwhile, W. Germany already has a permanent tax credit on which high technology companies can depend, and Japan's government offers its private investors in research loans which do not have to be paid back unless the research results in a revenue-generating product.

Clearly, these incentives have made the difference, for between 1970 and 1979, real growth of R&D expenditures increased by 80% in Japan, 45% in W. Germany, 30% in France—but only 15% in the United States. This lamentable lag in real growth has hurt and will continue to hurt the balance of trade, level of domestic employment, national security objectives, and rate of capital spending in America. In fact, I believe the current American R&D tax credit may be only the first step toward encouraging our high technology companies to spend more on research and expand their businesses.

Thus far, I have only been defending the value of the 1981 R&D tax credit, rather than discussing Congressman Shannon's proposals to expand it, because the credit is due to expire after 1985 unless its proponents prove its worth and give good reasons to extend it.

I think I have given good reasons. Furthermore, I must emphasize that it is all-important to make the credit permanent, rather than just extending it for three years, because of the relatively long planning cycles of most high technology businesses.

I have spoken to many of the high technology companies in my District, and they all say the same thing: R&D will start to slow down now because the high technology industry cannot assume that the tax credit will exist past 1985. Extending the tax credit for another three years will not do the trick when you are talking about 3-5 year planning cycles for most companies. Only making the credit permanent will give companies the same incentive to do research that they would have if they were doing business in many foreign countries.

That said, I would also like to add my support to Congressman Shannon's proposals to expand the credit by:

Making depreciation of research equipment an eligible expense;

Offering the credit to start-up companies;

Increasing the eligible expenditures incurred by contracting basic research to colleges and universities from 65% to 75%;

And creating an additional tax credit equal to 25% of a corporation's payments to colleges, universities, and other qualified, non-profit institutions that exceed a fixed historical floor.

These proposals to expand the credit will not only further encourage high technology industry to conduct research and grow, they will also help keep colleges and universities abreast of technological research by providing private industry with incentives to contract out their basic research. With more and more students and qualified engineers and technicians avoiding academic research because of out-dated equipment and low pay, I do think it is important to foster better research conditions in our schools. Other proposals that would make it easier for corporations to donate their equipment to colleges and universities also have my support since I understand that companies often exchange equipment for basic research to be carried out by the schools.

Once again, I thank you all very much for this opportunity to speak on behalf of the Research and Development Investment Tax Credit. I hope my testimony has increased this Committee's understanding of the tax credit's benefits in a local setting.

Chairman RANGEL. Thank you, Senator. Some of the witnesses will testify that we have scanty data in terms of how good the credit has been and how productive it has been, and that we have only had 6 months in order to take a look at it. Then they will turn around and say, so therefore we should make it permanent so that business can rely on it, because it is that reliance that would really give you the evidence that is necessary. So wrestle with that a little bit and get back to me.

Mr. SHEA. Certainly.

Chairman RANGEL. Congressman Shannon has made it abundantly clear to the Congress and this committee about how important this is to some of the industries located in his Commonwealth, and the Speaker has made it clear to other Members of the House.

Mr. Duncan?

Mr. DUNCAN. I have no questions.

Chairman RANGEL. Mr. Pickle?

Mr. PICKLE. I have no questions, but I appreciate your testimony. And you both gave very fine statements.

Chairman RANGEL. Thank you very much.

We will have a panel coming up next to testify on the R&E credit: C. William Schick, assistant controller, United Technologies Corp.; from the Computer & Business Equipment Manufacturers Association, John A. Young, president and chief executive officer, Hewlett-Packard Co.; International Business Machines Corp., Allen Krowe, senior vice president, finance and planning; American Telephone & Telegraph Co., Ian M. Ross, president, AT&T Bell Labs; Scientific Apparatus Makers Association, James A. Taylor, director of taxes, Varian Associates, Inc., and chairman, tax committee; and from the American Electronics Association, Dr. Joseph A. Saloom, senior vice president, corporate components technology center, M/A-Com, Inc.

Gentlemen, we thank you for taking time out of your business schedules to share your views on this tax matter for us. We want to assure each and every one of you, and the associations that you represent, that your entire testimony will be a part of our full record. Since today is a nonlegislative day, we have some scheduling problems that we are currently facing. Therefore, I would ask you to restrict your testimony to highlight what will be in the record. We will operate on the 5-minute rule and exempt those questions that members of the subcommittee would have. I would thank you if you could cooperate in that manner.

Also if it is not included in your testimony, oral or written, we would like to know whether your firm claimed the research tax credit, for what years and in what amounts, the specific types of research activities, whether the research was related to basic research, applied research, improvement of an existing product, or development of a new product, and the final product or process to be affected, or the type of product to which the research relates.

To have a substantial extent we are going to have to rely on your expert testimony as to how we can best serve the people of the United States with a sound tax policy. You know more than we do about whether firms have abused the existing system and whether the credit is serving its objective. So where possible provide us with information to assist us in improving the credit, rather than just telling us of your general support for the credit. That would be helpful.

Thank you. And I will ask Mr. Schick to head up the testimony for this distinguished panel.

STATEMENT OF C. WILLIAM SCHICK, ASSISTANT CONTROLLER, UNITED TECHNOLOGIES CORP., REPRESENTING THE CHAMBER OF COMMERCE OF THE UNITED STATES

Mr. SCHICK. Thank you very much, Mr. Chairman. The United States you know, has always been an important investor in R&D, and we continue to be the largest investor in terms of absolute terms and percentage of GNP, but I think it is generally recognized that at least since the late 1960s that our gap at least in certain areas, our lead has begun to narrow. We assume that there is little or no disagreement that increased R&D is essential for economic progress. However, we would like to address a number of issues on which there obviously is no consensus.

First, there is the issue of whether R&D will in fact stimulate research and development effort to the degree that is commensurate to the so-called cost to the Treasury. We are not aware that there has ever been or can be sufficient information to develop this as a conclusive matter. However, it is clear to us that there will always be more of something that costs less and less of something that costs more. Therefore, we consider it axiomatic that there will be more R&D as long as the R&D credit remains in existence.

As for my company, we claimed a $30 million credit last year, and I can tell you that if that is taken away, that we will have to reduce something, and that something could well be R&D.

Second, there is the issue as to whether the R&D credit is properly structured. As you know, the present structure provides that the credit is applicable only to R&D cost which exceed a rolling base period cost. Consequently, situations can arise where it is important for a particular firm to increase R&D efforts over the present levels but the credit is unrealizable by that firm because it is conducted at even higher levels during the base periods.

The obvious cure would be to eliminate the incremental part of the structure and to apply a rate resumably lower than 25 percent. This, of course, is the type of structure that underlies the investment tax credit. We would favor such a structure. However, the credit was enacted in 1981 using the incremental approach, and notwithstanding our preference for the first dollar structure, we continue our support for the present approach.

Third, there is the issue of what R&D efforts should be eligible. Treasury had in the past objected to the fact that R&D credits were being taken by businesses such as fast food restaurants, baked goods, home building, publishing, banking, stock brokerage, and movie production. You mentioned a few this morning, Mr. Chairman. Suspicion was expressed that the R&D activities of such businesses do not involve "high technology." Treasury also expressed the view that "trivial" or "style" R&D should not be eligible.

We support the view that the definition of R&D should be improved. We believe virtually all of the objections to the present definition could be removed by changing that definition so that eligible R&D effort is based on the physical and biological sciences. The Senate approach in its version of H.R. 4170 appeared to move in that direction.

Finally, we would like to again register our opposition to the process of "on again, off again" tax policy. This type of policy has been applied in many areas. In rapidly moving technologies such as electronics products, cycles can last 3 to 5 years. In other high technology industries such as aerospace products, cycles can last 10 to 15 years. In either case, research and development efforts must be carried out at a high level, year in and year out. American industry is committed to undertaking the necessary efforts but to carry them out we need to have stable policies.

I have one last comment, and that is that you referred to the fact that $7 billion would be the tax expenditure through 1989. Well, we are spending a lot of money for R&D, and it is our hope that we will be able to generate sufficient additional income to more than pay you back for that $7 billion.

Thank you very much.

Chairman **Rangel**. Thank you.

[The prepared statement and supplemental material follow:]

STATEMENT OF C. WILLIAM SCHICK, ASSISTANT CONTROLLER, UNITED TECHNOLOGIES CORP., ON BEHALF OF THE CHAMBER OF COMMERCE OF THE UNITED STATES

I am William Schick, Assistant Controller of United Technologies Corporation. Our company is a member of the Chamber of Commerce of the United States, which is the organization I represent today. Accompanying me is David E. Franasiak, the Chamber's Manager of Tax Policy. We appreciate having this opportunity to address important research and development tax policy questions.

United Technologies Corporation designs, develops, and manufactures products with high technology content. They include Pratt & Whitney gas turbine engines, Sikorsky helicopters, Otis elevators, and Carrier air conditioners. We are headquartered in Hartford, Connecticut. Our annual sales volume is 15 billion dollars. We invest over 800 million dollars each year in research and development (R&D). We carry out our work with nearly 200,000 employees.

SUMMARY

The U.S. Chamber vigorously supports all prudent steps which can stimulate R&D efforts in the United States. There is a consensus that the American business establishment is falling behind its foreign competitors in productivity. There is little doubt that this trend, in whole or in part, comes about from a decline in the level of U.S. R&D expenditures, relative to those of some other countries. We must not allow this trend to continue.

In recognition of our vital need to encourage, and to avoid discouraging, increased investments in R&D, without which we cannot increase jobs and exports, we believe that making the R&D tax credit permanent is essential.

I will summarize the U.S. Chamber's position on this issue.

The R&D tax credit is, and can continue to be, an important ingredient in stimulating R&D effort in this country. Clearly, Congress shared that view in 1981 when it enacted the credit. However, under present law, the credit's last year of life is 1985. We believe it is essential to make the credit permanent.

Other countries, including Canada and Japan, have R&D tax credits. In addition, some foreign governments provide direct funds, in some cases very substantial funds, for selected projects.

The credit has stimulated, and will continue to stimulate, essential increases in R&D effort. While the present credit could be changed to eliminate the incremental structure, we support the existing structure. We also endorse proposals to restrict eligible R&D effort to that based on the physical and biological sciences.

The nation's R&D shortfall cannot be cured in such a period as short as five years. R&D is, by its very nature, long term. To maintain and increase productivity, jobs, and competitiveness, R&D efforts must be conducted at high levels, year in, year out.

We strongly urge Congress to establish a generally stable tax policy, and in particular, to make the R&D tax credit permanent.

OUR VIEWS IN MORE DETAIL

The United States has always been an important investor in R&D. It probably continues to be the largest investor in the free world, both in absolute terms and in terms of percent of Gross National Product (GNP).

In terms of total R&D expenditures, expressed as a percentage of GNP, the United States has led the free world since at least the late 1960s, although in recent years our lead has substantially narrowed.

U.S. expenditures for non-defense R&D in the late 1960s are estimated to have been somewhat less, in terms of percent of GNP, than those of West Germany, Japan, the United Kingdom, and France. In the 1970s, expenditures of West Germany and Japan are estimated to have significantly exceeded U.S. levels, again on a percent of GNP basis.

All industrial progress, if not survival, depends on the development of new and inovative products and methods. Our competitor nations are working hard to stimulate their economic progress, and to employ their workers. Their objective is to out-sell us in the world marketplace, which, unfortunately, includes our own backyard and probably our own front yard.

We assume there is little or no disagreement that increased R&D effort is essential for economic progress. However, we recognize there are a number of issues on which it is not clear if there is a consensus.

First, there is the issue of whether the R&D credit will, in fact, stimulate R&D effort to a degree that is commensurate with the so-called "cost" to the Treasury. We are not aware that there has ever been, or can be, sufficient information developed to conclusively settle such issues. It seems to be clear that always there will be more of something that costs less, and less of something that costs more. Thus, we consider it axiomatic that there will be more R&D as long as the R&D tax credit remains in existence.

Second, there is the issue of whether the R&D tax credit is properly structured. As you know, the present structure provides that the credit is applicable only to R&D costs which exceed a rolling base period cost. Consequently, situations can arise where it is important for a particular firm to increase R&D efforts over present levels, but the credit is unrealizable by that firm because it conducted even higher levels of effort during the base period. The obvious cure to such a circumstance would be to eliminate the incremental part of the structure, and to apply a rate, presumably lower than 25%, to actual amounts expended. This is the type of structure underlying the Investment Tax Credit.

We would favor such a structure. However, the credit was enacted in 1981 using the incremental approach, and notwithstanding our preference for the first dollar structure, we continue our support for the present approach.

Third, there is the issue of what R&D efforts should be eligible. Treasury had objected to the fact that R&D credits were being taken by businesses such as fast food restaurants, baked goods, home building, publishing, banking, stock brokerage, and movie production. Suspicion was expressed that the R&D activities of such businesses do not involve "high technology." Treasury also expressed the view that "trivial" or "style" R&D should not be eligible.

We support the view that the definition of eligible R&D should be improved. We believe that virtually all of the objections to the present definition can be removed by changing the definition so that eligible R&D effort must be based on the physical and biological sciences. The Senate approach in its version of H.R. 4170 was generally acceptable. We enclose an appendix to our statement which discusses that issue at further length.

Finally, we would like to register again our opposition to a process that has developed over a period of years, which we refer to as on-again, off-again tax policy. This type of policy has been applied in many areas. In rapidly moving technologies such as electronics, product cycles can last 3–5 years. In other high technology industries such as aerospace, product cycles can last 10–15 years. In either case, research and development efforts must be carried out at a high level, year-in, year-out. American industry is committed to undertaking the necessary efforts. But to carry them out, we need sensible and stable policies.

Stability is needed for industry to plan how its resources will be acquired and how they will be employed. This is particularly true in R&D, the fruits of which can be realized only well beyond the time the R&D effort is undertaken. Aside from the substantive value of the various tax policies designed to stimulate productivity and jobs, one must ask how the industrial community can plan for the future without reasonable stability in tax policy.

Already, we have had too much on-again, off-again tax policy. I will briefly outline the history which leads us to that conclusion.

In 1981, Congress enacted the Accelerated Cost Recovery System, known as ACRS. It allows a business to recover the cost of machinery and equipment over a reasonable period. At the same time ACRS was adopted, the R&D tax credit was enacted.

Those steps were necessary to get our nation back on the track. In earlier years, other measures designed to increase production and jobs were enacted.

In 1962, the investment tax credit was enacted. This credit was intended to stimulate investment in plant, machinery, and productive equipment. The credit did that then, and it does it today.

In 1971, Congress passed the Domestic International Sales Corporation (DISC) legislation. DISC permits deferral of income taxes that would otherwise be due on profits earned from exports of products. This was important legislation that stimulated exports then, and the new Foreign Sales Corporation (FSC) will continue to do so today.

Then, at the height of the last recession, some of these measures were cut back. You will recall that the 1986 depreciation reform originally was proposed to have become effective in 1981. It would have established the cost recovery rate at 20% of the Declining Balance. But a change was made at the last moment because it was decided that the government could not absorb the reduced revenues until later. Instead, the 1981 law provided that the recovery rate was to be set at 175% of the Declining Balance in 1985 and 200% in 1986.

And now, the 1985 and 1986 depreciation reforms are lost. We did not agree then, and we do not agree now that the 1981 deferral and the 1982 reversal were wise acts.

At the same time the depreciation reforms were lost, the 10% investment tax credit, in effect, was cut back to 8%. Safe Harbor leasing was repealed.

In 1981, the Tax Code was changed to speed up corporate tax payments. A further speed-up provision was adopted in 1982.

In 1976, DISC was cut back, so that tax on profits on incremental sales only was deferable. In 1982, the DISC stimulus was cut back another 15%. In 1985, it is cut back another 5%.

And in 1985, the R&D tax credit will die.

Economic stimulus cannot be turned on and off like a spigot without causing severe change to the economy. It is with this recent history in mind that we urge Congress to make the R&D tax credit permanent.

CONCLUSION

The nation needs to employ resources in R&D long term. Our tax policy should reflect that long term need. This can be achieved by making the R&D credit permanent. Definitional changes designed to confine eligible R&D to efforts employing the physical and biological sciences are desirable. Eliminating the incremental structure of the present credit should be considered. Early resolution of this matter is desirable if not essential.

[Appendix]

Comments on Chapoton Statement

The Treasury Department, represented by John E. Chapoton, Assistant Treasury Secretary for Tax Policy, appeared at the Senate Finance Committee hearing on February 24, 1984, to comment on S. 2165.

S. 2165 would, among other things, revise the definition of R&D expenditures which are eligible for the Section 44F R&D Tax Credit. The revision is intended to remedy shortcomings in the existing definition.

PERCEIVED SHORTCOMINGS IN THE R&D DEFINITION

The Treasury Department believes that the present definition of R&D, as well as S. 2156's definition, is too broad. Treasury objects to credits being taken by businesses such as fast food restaurants, baked goods, home building, publishing, banking, stock brokerage, and movie production. Suspicion is expressed that the R&D activities of such businesses frequently do not involve "high technology" research.

While acknowledging that the S. 2165 definition is an improvement over the existing definition, the Department took specific exception to certain concepts in that proposed bill. For example, Treasury expressed objection to the S. 2165 concept, which would exclude from R&D tax credit eligibility only purely stylistic changes. Objection was expressed that S. 2165 would allow the cost of developing even trivial functional improvements. In an attempt to remedy these perceived shortcomings, certain concepts were proposed by Treasury which appear to be unworkable and ineffective. In addition, the concepts proposed by Treasury will undermine the basic purpose of the R&D tax credit. These matters are described in the paragraphs that follow.

CONCEPT OF SIGNIFICANT TECHNOLOGICAL IMPROVEMENT

The Department expresses the view that, to be eligible for the credit, the R&D effort should be intended to result in a "significant technological improvement." While an objective basis could be established for the purpose of determing whether a particular R&D effort is "technological," whether a particular R&D effort is intended to or does result in a "significant" improvement is merely a matter of someone's opinion.

It is unlikely that in any particular case, substantial facts will be present on which to base an opinion, beyond the fact that a taxpayer was willing to spend his own money on the R&D project. Logic suggests that the fact that a taxpayer is willing to expend his own funds in pursuance of an improvement should be conclusive that a planned improvement was intended to be achieved and that it was believed to be a significant improvement. Taxpayers do not knowingly or consciously expend funds on insignificant improvements.

No such concepts apply with respect to the Investment Tax Credit (ITC). To obtain the ITC, the taxpayer must merely acquire and put in use machinery and equipment. The ITC tax policy is certainly intended to result in increased investments in productive and useful machinery and equipment, but the administration of the ITC would become a shambles if the ITC were to be restricted only to "significantly improved" machinery.

In support of its contentions, the Department's statement presented an example where a taxpayer's new computer model represented "merely" an attempt to catch up to existing, widely available technology or to copy another manufacturer's popular model. The view was expressed that R&D costs expended to develop such a computer should not be eligible for the credit. On the other hand, if the technology underlying the competing computer was proprietary and secret—that is, not "widely available"—the catch-up effort would be eligible.

It is obvious that if such a concept were to be adopted in the Code or in the Regulations, both taxpayers and the Treasury Department would be faced with substantial uncertainty as to whether particular R&D programs are eligible for the credit. Uncertainty would be the result because it is virtually unprovable whether particular technology is "widely available." It would be virtually impossible to collect sufficient facts on which anyone could reasonably conclude whether the computer project was merely an effort to catch up or to make a significant improvement.

From a tax policy viewpoint, the wisdom of adopting such a concept is highly questionable. Suppose, for instance, that the competing product which the U.S. taxpayer wishes to "catch up" to is a Japanese product, based on "widely available" technology. The intention of the U.S. taxpayer is to "catch up" in order to produce a competitive product in the United States. Under the proposed Treasury concept, the U.S. taxpayer would be denied the R&D credit.

Thus, the adoption of the "Significant Technological Improvement" concept, even if it were capable of being reasonably administered, would defeat a principal reason that the R&D tax credit was adopted in the first place, namely that the United States has lost its once commanding technological leadership position, and a national objective is to "catch up" and regain its historic position of leadership.

CONCEPT OF SUBSTANTIAL RISK

The Department proposed that if a taxpayer faces substantial risk that an intended technological result could not be achieved, such "fact" would be conclusive evidence that the taxpayer intended to achieve a significant technological improvement. Under such circumstances, the R&D costs would be eligible.

This concept has the same defects as does the "significant improvement" concept. There are no facts which can enable one to conclude whether or not an R&D project has any particular degree of risk. If this concept is adopted, entitlement to the credit will depend on mere opinion. No tax policy is administrable if its administration depends on mere opinion. Moreover, this is a failure-oriented concept. Presumably, taxpayers who fail in their endeavors would have little difficulty in sustaining their R&D costs as creditable, but those who succeed would incur the burden of demonstrating that they might have failed.

If such a concept is adopted in the Code or Regulations, it is probable that most R&D projects—except failures—will result simply in unresolvable contention between the Internal Revenue Service and the taxpayers. How can Congress adopt tax laws or regulations where it is certain that reasonable people will disagree?

CONCEPT OF THE COMPONENT

The Treasury statement expresses the view that, if a taxpayer's intent is to develop a substantially improved component of a product, and the taxpayer incurred a significant amount of R&D costs with respect to other aspects of the product or process, the eligible R&D costs should be limited to the costs of developing the particular component.

An example was given where a taxpayer introduces a new personal computer. The taxpayer develops a new type of screen, incurring substantial R&D expenditures for developing the screen, and for combining the various parts, including the screen into a product. The components, other than the screen, are mostly widely available. On these facts, Treasury would consider the costs of developing the screen to be eligible for the credit, but proposes that the costs of combining the other components into the computer would not qualify.

This concept has significant tax policy shortcomings. The new computer screen is useless unless it can be integrated and made to function in the computer. Under the Treasury example, presumably no R&D effort is expended on the components that are widely available. The only R&D effort is on developing the screen, and then integrating it into the computer. The integration project is an essential ingredient in the development of the screen and the product.

For example, suppose a taxpayer develops a new jet aircraft engine that offers increased durability and reduced fuel consumption. The taxpayer agrees to provide the engine to an airframe producer that is producing a certified aircraft using a less efficient engine. The introduction of the new engine requires the airframe producer to establish an R&D program to make certain modifications to the aircraft so the improved engine may be installed. Without such modifications, the improved engine is useless and the airframe producer would have to continue producing a less efficient aircraft, with no competitive advantage over a similar European aircraft. Under the Treasury's "component concept," would the essential R&D program of the airframe producer be qualified for the R&D credit? It appears not.

It is highly questionable whether distinctions of this type are administerable, or represent solid tax policy. The development of any product begins with the development of its component parts. In actual practice, all the component parts of a total product must be individually developed, and must be designed to function in harmony with all the other components, which together comprise the final marketable product. Without the integration effort, the individual components are useless.

The design objective of each component may vary in degree of risk and on degree of intended improvement. In some instances, some of the components may involve little improvement. However, the worthiness of the final R&D objective must be considered by the taxpayer in terms of the total end product, not in terms of individual components. Therefore, aside from the administrative and practical problems that adoption of the "component" concept would create, it seems that eligibility of the R&D effort should be considered primarily in light of the total end product.

CONCEPT OF ROUTINE OR TRIVIAL IMPROVEMENTS

Treasury expressed the view that the R&D credit should be allowed only with respect to development programs intended to result in meaningful functional improvements, but "routine or trivial" improvement programs should not be eligible. Moreover, programs intended to achieve changes in style would not be eligible.

This is another concept, the administration of which would be based on unprovable facts. Administration of such a concept would rest on unsupported opinion. While it is understandable that it is not in the nation's interest to allow credits on trivial matters, presumably not much money is spent on "trivial" improvement. It is not wise to introduce a complex and unadministerable concept to resolve a trivial matter.

The concept appears to be intended, at least in part, to address the problem that arises when the distinction between functional improvements and style changes becomes blurred, it being implied that style is trivial. A currently popular example, referred to in the Treasury statement, is the body of an automobile, where aerodynamic improvement can reduce fuel consumption, but another result of an aerodynamic improvement program can be to change the style or appearance of the body.

Under S. 2165, if the characteristics of a new or improved product are predominantly functional rather than stylistic, the taxpayer would be entitled to the credit. Treasury objects to the S. 2165 definition since it would exclude only purely stylistic changes, allowing "trivial" functional improvements. There is a question, from a tax policy viewpoint, whether style should be distinguished from function. The fundamental purpose of the R&D tax credit is to make the nation more competitive. To be more competitive, the nation needs to produce improved products and processes. Frequently, style is an important aspect of consumer products.

Accepting, for the purposes of analysis, that it is proper to address the functional vs. style question—where the two characteristics are merged—it does not appear useful or practical to resolve the question by introducing the concept "trivial vs. meaningful." Just as it is difficult to separate function from style, it is probably even more difficult to distinguish "trivial" from "meaningful," or "routine" from "non-routine."

If it is decided to render style improvement ineligible, it appears that an approach along the lines of S. 2165 may be the best approach. Projects intended solely to improve style and taste could be made ineligible, but where style or taste are only one aspect of the program, the entire cost would be eligible.

CONCEPT OF "EXPERIMENTATION IN THE LABORATORY OR SCIENTIFIC SENSE"

This concept appears to be the most useful of those discussed in Treasury's statement. A generally accepted concept of technology is that it is created by engineers and scientists working in laboratories. The process consists of an effort intended to result in a new or improved product or process.

Here is a generally accepted definition of R&D. R&D consists of Basic Research; Applied Research; Development; and Systems and Concept Fomaulation. Basic Research is directed toward an increase in knowledge of science. The primary aim is a fuller knowledge or understanding of the subject, rather than toward practical application. Applied Research takes place after related Basic Research, but is directed toward attempts to exploit Basic Research discoveries or improvements in technology, materials, processes, methods, devices, or techniques. It attempts to advance the state of the art. Development is the use of scientific knowledge in the design, development, test or evaluation of a potential new product or services, for the purpose of meeting specific performance requirements or objectives. It includes the functions of design engineering, prototyping and testing. System and Concept Formulation are analyses and study efforts directed toward the identification of desirable new systems, equipment or components, or desirable modifications to components and existing systems or equipment.

Thus, R&D effort consists of concept formulation, design, acquisition of material, fabrication, and tests—all iterated and reiterated. The effort is performed directly by or is supervised by engineers and scientists whose objectives are to develop the new or improved product/process. The effort includes the acquisition of materials, model shop fabrication of prototype components, the subcontracting of fabrication of prototype component parts, integration of components, and the test of those materials and components, and the complete product, all under the control of an engineering department.

Engineers and scientists are readily identifiable by their position descriptions. The purpose are readily identifiable by their position descriptions. The purposes of the work they do is identified by the written description of the functions and purposes of the engineering departments in which they work. Their objectives are readily identified by the work statements they prepare, which are approved by their management. The costs they incur are identifiable by analysis of their departmental budgets and the R&D cost accounts for which they are responsible. It is the cost of the effort that engineers and scientists perform, supervise or are responsible for that should be eligible for the R&D credit. This area needs further examination, which should yield an acceptable definition of eligible R&D.

It could be argued that only large companies organize R&D programs in such a way that the documentation discussed above is available. This standard could be made applicable only to those taxpayers which expend R&D above a certain threshold. In smaller cases, the principle set forth in S. 2165 may suffice.

S. 2165 DEFINITION

While the S. 2165 definition may have some shortcomings, it is superior to the present definition and, for the reasons set forth here, it is far superior to the definition proposed by Treasury. If it is intended that improvements in food, clothing, banking services, home building, etc., should not be eligible, perhaps it should simply be enacted that projects in those areas are not eligible. Certainly the producers of those products and services will benefit from improved productivity of the nation's technical sector.

UNITED TECHNOLOGIES,
Hartford, CT, September 13, 1984.

Mr. CHARLES B. RANGEL,
Chairman, Subcommittee on Oversight of the Committee on Ways and Means, Longworth House Office Building, Washington, DC.

DEAR MR. CHAIRMAN: On August 3, 1984 on behalf of the Chamber of Commerce of the United States, I submitted a statement and provided testimony to the Oversight Subcommittee concerning the Research and Development Tax Credit.

At that hearing, you asked that the witnesses provide certain supplemental information, which I am pleased to provide. The information requested was set forth in a paper circulated by the Subcommittee staff. The headings below are taken from that paper. All of this supplementary information relates to United Technologies Corporation.

1. *Whether your firm and/or association members claimed the research tax credit. If so,*

a. For what year(s) and

b. In what amount(s).

United Techologies Corporation did realize a Research and Development Tax Credit for each of the years 1981, 1982, and 1983. The amounts of credit were $10 million, $20 million, and $40 million, respectively, in those years.

2. *The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.*

The types of research included basic research, applied research, product improvement, and product development. Also certain software development and certain manfacturing engineering costs were included. These costs were related to the development of new processes.

3. *The final product or process to be affected or created.*

A list of representative final products and processes is attached to this letter. This list was compiled from information provided by representatives of our operating units.

4. *If the credit had not been available.*

a. the specific product or experimental activity that would not have been undertaken,

b. whether such activities would have been deferred to the future or never undertaken, and

c. the resulting amount of reduction in overall research spending.

If the Research and Development Tax Credit had not been available during the years 1981 through 1983, the company would have had $70 million less funds available for operations during those years. It would have been necessary for the company to reduce expenditures by amounts which would have taken into account the above-stated hypothetical shortfall in funds. It is not possible to state exactly how costs would have been reduced had the funds not been available or whether the R&D activities would have been deferred until a later period, since in fact the funds of the R&D tax credit. In our company, and we believe in most others as well, R&D is largely a discretionary expense. While year-in, year-out R&D effort is required for both individual company and for national economic survival, the amount of R&D performed must be tailored to the amount of resources available. For this reason, R&D budgets are always cut, because there never are sufficient funds to perform all worthwhile efforts.

For these reasons, it is my opinion that R&D budgets would have been cut if the R&D tax credit had not been available.

5. *The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.*

The primary reason the company undertakes research and development is to develop new products and improved products. R&D is not undertaken for the purpose of reducing federal income taxes. However, the R&D tax credit generates funds which make it possible to undertake the efforts necessary to develop new products.

6. *The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.*

Most expenditures which were "qualified" expenditures in calculating the company's tax credit were reported as Research and Development costs in reporting research costs in reports made to the SEC. Exceptions include certain computer software development costs, and certain manufacturing engineering efforts, the objectives of which are to develop new processes. Computer software development costs are recorded under the function to which the software is applicable. Manufacturing engineering is recorded as a product cost (factory overhead).

7. *If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.*

The advantages of making the tax credit permanent and how its permanency would affect long-term research budgeting is discussed at some length in The Chamber's statement. (As we pointed out at the Hearing, "permanent" does not mean forever. The credit should be retained until such time as there is a consensus that the objective of the credit has been met. The objective is to encourage our nation's business community to restore its position as a world technological leader. When that objective can be achieved is not predictible. Thus, a "sunset" is incompatable with the objective.)

8. *If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.*

If the definition of qualified research expenditures were to be narrowed to include only basic and applied research activities, but to exclude development expenditures, the objective of the R&D Tax Credit would be substantially undermined. This is because the ultimate purpose of R&D is to develop new and improved products. Basic and applied research efforts, while being essential first steps in the product development process, are not of value until the results are translated into developed or improved products.

A very significant portion of United's research and development effort consists of product development and product improvement, which is conducted after basic and applied research is performed. The product development function is very significant to United because, in most of our lines of business, substantial additional engineering, design, and testing is required in order to translate the results of applied research into an operable product.

In our company, we have performed and will continue to perform the basic and applied research at that level which enables us to know whether we can produce new products. The question always is, do we have sufficient resources to translate that which we learn from the basic and applied research into useful products? In our business in particular, the cost of development is enormous. The cost is high because development requires the fabrication of experimental parts and prototypes which require extensive and costly testing.

If the R&D tax credit were to be limited to basic and applied research, the credit realized by United would be substantially reduced. The purpose of the R&D credit is or should be to enhance the development of new and improved products, and the exclusion of product development from the definition of eligible expenditures will defeat that purpose.

Finally, we question whether a clear distinction can be made between basic/applied research and development research. While these terms are generally understood conceptually, there may be considerable practical difficulty in determining whether a given R&D effort is applied research or is development effort. This is because applied effort shades into development effort, and development effort may result in a need for more applied effort, all this coming about because research consists of an iteration, and then a reiteration, and so on. The existence of this definitional problem is, of course, not necessarily a dispositive reason for not distinguishing between the various types of research, but there is no doubt that introducing this distinguishment would contribute to an added layer of administrative complexity.

We very much appreciate the opportunity to provide our views on the R&D Tax Credit. I emphasize again that the higher levels of business income that will be generated by Research and Development will repay many times over the cost to the Treasury of the R&D Tax Credit.

Very truly yours,

C. William Schick, *Assistant Controller.*

Attachment.

Research and Development Projects

PRODUCTS WHICH ARE PRINCIPALLY PRODUCT DEVELOPMENT/IMPROVEMENT

Aircraft engines

Develop PW 2037 new engine (30,000–45,000 lb. thrust). Reduce fuel consumption, reduce cost and weight, and satisfy stringent durability and maintenance cost goals.

Develop PW 4000 new engine (above 45,000 lb. thrust). Develop best performing, most durable engine with improved fuel consumption and reduced maintenance cost.

Fan and Compressor Research.—Advance the fan radial and intrablock design capability by developing predictive loss systems using three-dimensional flow solver to increase efficiency of these parts.

Combustion Technology Development.—Develop advanced cooling methods to increase life of combustor and decrease maintenance costs.

Turbine Technology.—Improve turbine efficiency by reducing profile and endwall losses and by improving aerodynamics and internal cooling concepts.

Structure and Dynamics Technology.—Develop new materials to improve engine reliability and reduce development and maintenance costs.

Component Improvement Program.—Apply new technology to various components to increase durability and reliability and reduce cost and weight.

Develop advance casting processes—directional solidification and single crystal to produce superior quality turbine blades with higher temperature capabilities produced at lower manufacturing costs.

Other aircraft/aerospace components programs

Prop-Fan Research.—Conduct research on prop-fans. High speed propellers (i.e., prop-fans) operating in the 0.6 to 0.8 Mach number speed range of today's commercial turobfan powered aircraft. Provide approximately 20 to 30% savings in fuel usage and 10 to 15% reduction in direct operating cost (when compared to equal technology turbofans). Research and development efforts are being conducted to help bring prop-fan propulsion technology to a level ready for acceptance by industry for commercial application. These efforts include design and development activities related to prop-fan aerodynamic performance, acoustics, and structural integrity.

Flash Evaporator Heat Rejection.—Conduct a flash evaporator heat program. Design, develop, and test a thermal/humidity control feasibility unit for Orbiter application. Develop grooved surfaced evaporator capable of providing 3.8 times more evaporative surface area than the SOTA flat plate surfaces and with an increase in the surface heat transfer coefficient. Optimize spray nozzle design/spray pattern to effectively integrate with the evaporator to result in 9 times the heat flux capabilities of current systems.

Helicopters

Micro-Electronics and Optics Application Technology.—Apply micro-electronics and optics to helicopters. Continue progress in the application of micro-electronics and optical technology to helicopter systems to improve reliability, enhance accuracy, and lower cost. Design and develop a low air speed system utilizing a silicone pressure sensor and optical slip ring. A electronic chip detector and laboratory hardware which enables this detector to sense chip-like particles in oil and insensitivity to air bubbles.

Advanced Rotorcraft.—Conduct an advanced rotorcraft program, relating, in part to, a new generation of light utility aircraft. Complete preliminary design studies of a helicopter, coaxial, and advancing blade concept solution. In addition, make studies to determine methods of improving the radar cross section and other critical attributes of the air vehicle. Investigate tilt rotor design to examine the applicability to future military roles.

Advanced Cockpit and System Integration.—The primary thrust in design of advanced cockpits is the development of a single pilot cockpit capability. Initiate detail design effort for aircraft modification and avionic equipment installation. Design and construct a test bed vehicle.

Low Observables Technology.—Conduct investigations to evaluate radar cross section and acoustic emissions. Explore rotary wing designs with the intention of producing reduced radar visibility.

Composite Structure Design Technology.—Conduct a composite structures design program. Design a data base and build it to test and support a number of composite material concepts. Through the use of laser holography, make measurements during testing, and evaluate design changes. Conduct a series of specimen crash tests of fuselage understructure.

Elevators

Electronic Controls.—Modernization allows old elevators to be renewed to performance standards of current systems.

Mid-Range Variable Frequency.—Perform effort to incorporate latest advances in geared technology, microprocessor, power electronics and materials to traction of elevators.

Hydraulic Elevators.—Apply microprocessors and motion development to hydraulic elevators.

Rope Shuttle.—Apply elevator techniques to development of new people mover.

Linear Motor.—Develop new techniques to simplify elevator functioning.

Modular Escalator Drive.—Apply new geared technology lubrication development to escalators.

Semiconductor Technology

Volatile memories—DRAM, SCRAM; non-volatile memories—RMS; microcomputer components.

Develop 68200, a 16-bit single circuit microprocessor in multiple versions.

Develop 68590, ethernet communications link controller circuit.

Develop 68564, serial input/putput peripheral. This circuit allows serial interface to the 68000 microprocessor, providing a required link for 16-bit computer design.

Air conditioners

Compressor Research: Program Mission.—Develop technology to assist in the design of positive displacement and centrifugal compressors, to be more cost effective, reliable and efficient, maintain and extend its product leadership.

Environmental Control Research: Program Mission.—Develop advanced technology in the fields of indoor environmental control, air handling and noise control which will lead to new and innovative systems and equipment.

Coordinate projects in air handler design and application for low noise and high efficiency; residential and commercial building environmental control system concepts to provide temperature humidity and air pollution control; product integrated electronic control concepts to provide building energy management, monitoring and diagnostics; and the development of system simulation capability and analytical tools for sound, vibration and air pollution control.

Advanced equipment research

Program Mission.—Identify and evaluate new and advance HVAC systems, equipment and component concepts.

In support of this mission, projects are conducted in areas of gas furnace development, burner research, field monitoring, air conditioning system simulation, air conditioning design and test, electronic controls, materials evaluation and technology assessment.

PROJECTS WHICH ARE PRIMARILY AND APPLIED RESEARCH

Manufacturing technology

Nondestructive Inspection.—A wide variety of techniques are being explored for high-precision, on-line testing and inspection of manufactured products. These include concepts employing holography, optics, ultrasonics, eddy currents and acoustic emission.

The effort to improve and augment robot capabilities through the use of sensors, external computers, and avanced software continues in 1984. High-level software, including off-line programming techniques and data base interfacing, as well as robot-specific software for sensor-based robot control, is being developed. Research in the areas of vision, sensor development, light metal removal, welding, and samll component assembly is also being conducted. Vision system research includes an evaluation of a five-degree-of-freedom vision sensor, integration of the sensor with a robot, and development of algorithms for robot motion control. Welding research includes development of process models, definition of sensor tracking requirements, and formulation of control concepts for seam tracking and adaptive weld process control. Research in assembly includes investigation of tactile sensing, error correction, CAD-directed operation and articulated gripper concepts.

Microelectronic Materials and Processing.—The development of advanced state-of-the-art microelectronic devices and integrated circuits requires (1) techniques for semiconductor and thin film materials preparation and processing, and (2) computer codes for modeling microelectronic devices. Develop specific equipment and processes required for ongoing progress in gallium arsenide (GaAs) and silicon device application as well as new technologies in support of research on advanced GaAs and silicon-based discrete devices and integrated circuits.

A fundamental aspect of advanced semiconductor device development is the growth of epitaxial thin films of gallium arsenide, gallium aluminum arsenide, and related materials suitable for high-frequency, high-temperature, and high-speed devices. Chemical vapor deposition (CVD), molecular beam epitaxy (MBE), liquid phase epitaxial growth, and ion implantation technologies are being developed.

Computer science

A new initiative has been established to address long-term research in computer science. This effort will support and complement the program to incorporate computer and microelectronic-based systems in UTC products. Advanced computer programs and software development systems will also increase manufacturing productivity. The 1984 program addresses two areas: (1) artificial intelligence (AI) technology, and (2) software engineering.

Industrial lasers

The general objectives for the 1984 program are: (1) the development of more reliable, less expensive industrial laser processing systems, and (2) development of new industrial laser processes and applications for UTC divisions. A major thrust is the testing of a new blower designed to increase the laser power output without an attendant increase in laser cost.

Fiber optics and electro-optics

The 1984 program continues the ongoing effort in fiber-optic sensors and initiates new programs in the application of fiber-optic and optoelectronic technology to high-speed data transmission and wide-bandwidth signal processing. Work continues on the fabrication and characterization of special-purpose optical fibers and other related components. Improved techniques for the production of multicore optical fibers will be developed, and analytic modeling of these structures to provide design guidelines will continue.

Materials and structures

The objectives of the Materials and Structures program is three-fold: to improve the structural and nonstructural materials currently in use in UTC products, to develop new materials for use in high-technology applications, and to develop improved methods for analysis of these materials in various applications. The program consists of three major subcategories. These are Composits materials, a class of materials which it is believed will play a major role in the products of the future, Materials Research, which is concerned with new and improved materials and methods for their analysis and the structures of which they will be a part, and Materials Testing, which is concerned with the development of improved techniques for the experimental evaluation of materials properties and characteristics.

Basic laser research

Basic laser research is focused on several of the more promising classes of chemically excited "short-wavelength" lasers. In addition basic research on relaxation and energy transfer is continuing to support the HF/DF chemical laser programs.

Chairman RANGEL. Mr. Young.

STATEMENT OF JOHN A. YOUNG, PRESIDENT AND CHIEF EXECUTIVE OFFICER, HEWLETT-PACKARD CO., REPRESENTING COMPUTER & BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION

Mr. YOUNG. Mr. Chairman, my name is John Young, president and chief executive officer of the Hewlett-Packard Co. I also serve as Chairman of the President's Commission on Industrial Competitiveness. Today, however, I am appearing on behalf of the Computer & Business Equipment Manufacturers Association, CBEMA, and the views I express are the views of CBEMA and its 42 member companies.

In my written testimony, for your information, I have appended comparative R&D tax incentives for other countries, so that you will have that for your record.

Thank you for this chance to appear before the subcommittee to urge the permanent extension of the R&D tax credit. Let me express my strong support from three different perspectives.

First, a national view. U.S. tax policy should encourage R&D because this activity produces a rippling of benefits that are felt throughout the country. Technological advances lead to productivity growth which allows us to earn the higher wages that we enjoy compared with our competitors abroad. New technologies spawn new industries and make existing ones more competitive internationally. Many of our modern service industries rely on computer and other electronic technology. Even older industries benefit. For example, the modern car contains several microprocessors. Technology is quite clearly the foundation for much of our economic health and is probably our strongest national competitive advantage in the world markets.

Let's take a second view on R&D tax credits from a perspective of those industries classified as high technology. American companies are facing mounting pressures from abroad. These new competitors benefit from a range of governmental policies targeted to nurture them. Among those measures are R&D tax credits which are already provided by Japan, Canada, Great Britain, Ireland, and France. Competitive pressure from abroad is certainly having its effect. In the last decade, fully eight out of 10 America's high technology industries have lost world market share. Last year the U.S. had a $9 billion trade deficit with Japan in just electronics. That is almost the same size as the negative trade balance in August.

Now for the third perspective, that of a business person who is responsible to stockholders and employees for the profitability of an organization. There are a lot of reasons I might be tempted not to invest in R&D, and as a decisionmaker I have many competing needs to balance. Some more potentially promising R&D projects just can't be financed. R&D is also risky. There is always the temptation to think of short-term results rather than investing for the long term.

Lastly, and related to this short-term perspective, every dollar spent on R&D comes directly off the bottom line of our profitability. In contrast, investments in plant or equipment can be spread out over 25 or 40 years for financial reporting purposes. With this kind of investment, the company gets the benefit of the building, but recognizes the cost overtime. With R&D you have the opposite scenario. You pay immediately for a result you don't fully get for several years, so R&D is the kind of expense that is sometimes difficult to explain to stockholders.

The R&D tax credit directly addresses this corporate budgetary bias that may tempt us to shortchange long-term projects. The credit provides a direct benefit to the company's earnings and in the same year that the expenses are incurred. Because of this benefit, a company can spend significantly more on R&D. For example, without a credit every $10 million additional outlay represents an after-tax impact of $5.4 billion. With the credit, that impact is only $2.9 million.

The R&D tax credit adopted in 1981, was only fully phased in last year. Yet we have reason to believe it has been successful in spurring growth in R&D spending. Despite a recession, R&D outlays in the computer industry rose by 19.5 percent in 1983. The total amount spent, $5.9 billion, represents 44 percent of pretax profits.

For my own company, we have increased R&D spending from $273 million in 1980 to $493 million last year. The important thing is we increased our spending from 8.7 percent to 10.5 percent as a percent of sales. This was a conscious management decision after reflecting on the benefits of the tax credit.

I believe the credit is an effective method of encouraging the innovative inquiries that benefit the entire economy, and I encourage the extension of this credit. It is a strong incentive. We are just beginning to see its positive effects and we eagerly await its full effects. I strongly urge that the credit be made permanent as soon as possible. It is the kind of national long-term investment from which we all reap future benefits.

Thank you.

Chairman RANGEL. Thank you, Mr. Young.

[The prepared statement follows:]

STATEMENT OF JOHN A. YOUNG, PRESIDENT AND CHIEF EXECUTIVE OFFICER, HEWLETT-PACKARD CO., ON BEHALF OF THE COMPUTER & BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION (CBEMA)

My name is John A. Young, and I am President and Chief Executive Officer of the Hewlett-Packard Company, located in Palo Alto, California. I also am Chairman of the President's Commission on Industrial Competitiveness. However, I am appearing today on behalf of the Computer and Business Equipment Manufacturers Association (CBEMA). The views which I present today are those of CBEMA and its member companies and do not necessarily represent the positions of either the Administration or the President's Commission.

CBEMA is an association composed of 42 manufacturers of computer systems, sophisticated business equipment, and other high technology electronics products. At Hewlett-Packard we employ almost 60,000 people in the United States in the design and manufacture of electronic instruments and computers. Almost half of our business is international, and we are the thirteenth largest exporter in the United States. Hewlett-Packard is the Nation's third largest private electronics research organization, and we believe that our past growth and success have stemmed from our ability to innovate and to bring the fruits of our research to market.

I welcome this opportunity to appear today to assist this Subcommittee in its effort to review the impact of the tax credit for research and development (R&D) activities and to strongly urge the permanent extension of that credit. The R&D credit presently is scheduled to expire at the end of next year. Legislation to make the R&D credit permanent, H.R. 4475, has been co-sponsored by a majority of Democratic members and a majority of Republican members of the full Ways and Means Committee and has been co-sponsored by 9 of the 11 members of this Subcommittee. Similar legislation making the credit permanent passed the full Senate earlier this year.

The prompt enactment of legislation making the R&D tax credit permanent is the paramount tax legislative priority of CBEMA and its members.

THE FUNDAMENTAL ROLE OF TECHNOLOGY IN AMERICA'S ECONOMIC WELL-BEING

Technological leadership is one of the Nation's most important resources. Technology always has been the foundation for America's high standard of living. We have incorporated technology into our products, making them so unique that we can charge a premium price. Our application of technology to the manufacture of products has increased our productivity to the point where our products can be cost competitive in world markets, even with a workforce that earns a higher wage than the workers of many of our foreign competitors.

The encouragement of innovation should be a national goal because the entire Nation benefits from scientific advances. Industries that invest more in R&D perform better in international markets than those industries which do not. For example, a 1982 report by the National Science Foundation indicated that products in R&D-intensive industries have a positive trade balance of $50 billion, while products from other manufacturing sectors racked up a trade deficit of almost $40 billion.

Moreover, the benefits of technological innovation extend well beyond high technology companies to many of today's services industries—finance, insurance, banking, retail trade, publishing—that use the information processing technology developed by our industry as part of their own competitive edge. Indeed, many new industries have been spawned as a result of the ripple effect that technological advances produce.

Therefore, concern over U.S. technological leadership and innovation should not be limited to those companies directly engaged in its creation. Rather, such leadership and innovation constitute a fundamental underpinning of the overall strength and long-term growth of our economy, the standard of living we enjoy, our competitiveness in world markets, and our national security.

THE IMPORTANCE OF EXPANDING U.S. CORPORATE R&D

However, our once unchallenged preeminence in science and technology is being overtaken by competitors throughout the world. The competitiveness of the American high technology industry no longer can be taken for granted. According to a report prepared last year for the Cabinet Council on Commerce and Trade, entitled "An Assessment of U.S. Competitiveness in High Technology Industries", the United States lost world market share in eight out of ten high technology industries over the past decade.

The fundamental characteristic of the U.S. high technology electronics industry is that in order to survive companies must continually develop and apply new technologies and products. A very substantial portion of the sales of CBEMA members, as well as those of other companies in the high technology electronics industries, lies in products that were not even in existence just a few years ago. For example, at Hewlett-Packard, more than two-thirds of 1983 orders came from products introduced during the previous four years, and more than one-half of 1983 orders were for products introduced since 1981.

Today's technology not only is dynamic, but is very geographically mobile as well. Industrializing nations such as Taiwan and Korea have access to state-of-the-art technology from both the United States and Japan and can rapidly transform that technology into marketable products. A technology transfer process that formerly took years now takes only months or even weeks. Moreover, the rate of development of new technology is increasing, and the life cycle of products is being reduced. In this highly competitive environment, an electronics company which fails to continuously advance technologically will find that its products have been rendered obsolete by foreign competitors.

THE NEED FOR R&D TAX INCENTIVES IN THE UNITED STATES

While there clearly are significant competitive pressures for U.S. high technology electronics companies to engage in R&D, these companies are also constrained for a number of reasons in the extent to which they can respond.

First, a high technology company such as mine always will have more potentially productive R&D projects than can be properly financed. As chief executive, I face the difficult task of allocating our limited budgetary resources among R&D projects seeking to develop new products, investment in plant and equipment to expand production of existing products, R&D projects attempting to produce innovative processes to modernize our production, more vigorous marketing efforts, and a host of other competing needs. The tax code inevitably affects corporate decisions to fund these competing needs.

Second, the R&D process is fraught with risk and necessarily has a long-range focus. When companies are determining where to invest their resources, there always arises the question of balancing the short term and the long term. The short term always seems to have a greater sense of urgency associated with it, and therefore a bias can arise towards cutting into long-term programs in favor of the short-term programs.

Third, every additional dollar spent on R&D means a dollar less in pre-tax earnings per share. R&D costs are a direct hit to the corporate bottom line unlike investment in a new plant, for example, which may be spread out over 25 to 40 years for financial reporting purposes.

Fourth, a company's capacity to fund research depends on its ability to reap rewards from that risky investment. In economic terms, a tax incentive for R&D is necessary because those who undertake a particular research endeavor are unable to capture all of the private and public benefits which flow from that project. For example, in earlier work, Professor Mansfield and his colleagues estimated that the social rate of return across 17 industrial innovations was more than twice as high as the private rate of return. (See Mansfield, Rapaport, Romeo, Villami, Wagner and Husic. "The Production and Application of New Industrial Technology" (1977) 157.) Basic research in the fields of physical science, mathematics, or engineering provides the foundation upon which future technological advances are built. That research by definition has no immediate commercial application, but instead advances knowledge in the field generally. Moreover, even in the product development area, any particular company performing research is in fact unable to capture all of the benefits arising from the project because in the high technology electronics industries it is impossible through patents, copyrights, and other legal means to truly protect the economic value of the technology. Competitors, through reverse engineering coupled with their own research, often are able to ultimately develop comparable or improved products by building on the foundation of their competitor's R&D effort.

These factors taken together produce pressures on U.S. corporations to invest less heavily in R&D than might be optional from a national economic point of view. Incentives provided by our tax laws for R&D activities can counteract these pressures.

Finally, to enable U.S. industry to remain competitive with foreign industry in the development of new products and processes, U.S. tax incentives are necessary to counterbalance the R&D tax and other incentives provided by the governments of these foreign competitors. The governments of these foreign competitors often have targeted these industries for special nurturing. This support may take the form of protected markets for emerging technologies, subsidized government loans, a panoply of special tax credits, allowances, and exclusions, export subsidies, and government sponsorship of collaborative research efforts in key technological fields. For example, in the area of collaborative research, the Japanese Ministry of International Trade and Industry has initiated and funded projects in "fifth generation" computers, robotics, software systems, and very large scale circuit technologies.

In enacting the R&D credit, Congress pointed to the close and fundamental relationship between this Nation's R&D activities and U.S. "economic growth, productivity gains, and our competitiveness in world markets" and the resulting need to promote continuous growth in R&D expenditures. (House Rept. No. 97-201, at 111; Sen. Rept. No. 97-144, at 77). Our foreign competitors certainly appreciate this link between R&D and competitiveness and productivity. Countries such as Canada, Japan, West Germany, Mexico, Spain, and the United Kingdom have adopted tax credits to encourage domestic R&D activities. Just recently France enacted an R&D tax credit that closely resemble the U.S. credit. Many countries, such as Canada, the United Kingdom, Korea, France, and Mexico either permit an immediate write-off of capital expenditures for R&D or permit special generous depreciation allowances for investments in R&D facilities and equipment.

Not unsurprisingly, our foreign competitors, led by Japan and West Germany have devoted more resources, as a percentage of gross national product (GNP), to R&D over the past 20 years than has the United States, with West Germany annually spending approximately 2.15 percent of its GNP on civilian R&D in recent years and Japan spending nearly 2 percent of GNP, as compared with only 1.66 percent of GNP spent by the United States prior to the enactment of the R&D credit. Japan and West Germany correspondingly have experienced much higher rates of growth in productivity—466 percent by Japan, for example, as compared with 69 percent by the United States over this period. In the United States, it is well established that, prior to the enactment of the R&D credit, the decline in U.S. productivity growth over the last decade paralleled the then declining pattern of U.S. R&D spending. In this context the adoption and continuation of U.S. tax incentives for R&D are not only justifiable, but necessary to help assure the competitiveness of U.S. workers and industries.

THE IMPACT OF THE CURRENT R&D TAX CREDIT

The R&D tax credit was originally adopted by Congress in 1981 to fulfill two objectives. First, the credit was intended to provide a substantial incentive for increases in R&D spending by U.S. companies, thereby increasing the ability of U.S. industry to remain competitive with foreign industry in the development of new and improved products and processes for world markets. Second, the R&D credit was intended to permit high technology companies—which have among the highest effective tax rates in U.S. industry—to participate in the overall reduction in tax burdens undertaken in 1981, thereby overcoming a major deficiency of ACRS, which provides very little tax benefit to most high technology companies.

Therefore, in analyzing the effectiveness of the R&D credit, the proper questions to ask are: whether the credit has provided some significant incentive for companies in the high technology industry to expand R&D efforts; and whether the credit has been an effective mechanism for reducing the tax burden of an entire sector of our economy that bears a disproportionately high level of taxes in an intensely competitive world market. My statement will focus primarily on the first of these questions.

The R&D Credit As An Incentive. While the R&D tax credit, adopted in 1981, was only fully phased in last year, we believe that the credit thus far has been successful in spurring growth in research and development spending. First, R&D spending remained strong in 1981-83 during the most severe economic recession since World War II. In fact, total corporate R&D spending steadily increased from $30.5 billion in 1980 to $35.4 billion in 1981 and $39.2 billion in 1983. (Business Week R&D Scorecard—1983, July 9, 1984, based on a survey of 800 companies). Aggregate R&D

spending increased in 1983 by 9.8 percent over 1982, providing an increase in real terms of nearly 6 percent. At my own company, Hewlett-Packard, R&D spending grew from $273 million in 1980, the year before the enactment of the credit, to $349 million in 1981, to $424 million in 1982 and to $493 million in 1983. R&D spending as a percentage of sales at Hewlett-Packard grew from 8.7 percent in 1980 to 10.5 percent in 1983.

R&D outlays by the computer industry rose 19.5 percent in 1983 to $5.9 billion, continuing a pattern of significant increases since 1981. This 1983 spending by the computer industry represented almost 44 percent of pre-tax profits. Similar patterns emerged in other high tech industries. The semiconductor industry increased its R&D spending by 21.6 percent in 1983 to $734.8 million. The telecommunications industry R&D spending grew by 31 percent to $1.3 billion.

By contrast, during the 1981–83 recession, total corporate expenditures for investment in plant and equipment fell from $216 billion in 1981 to $207 billion in 1982. Thus, R&D budgets fared well when compared with the budgets of most other corporate departments during the tight financial squeeze brought about by the recession despite the high degree of economic uncertainty, lower cash flow and profits and higher interest rates during this troubled period. We believe that R&D spending showed continued strength in substantial part because of the more favorable tax treatment much projects receive under the R&D credit as compared with other potential company expenditures. During the present period of strong economic growth, the R&D credit continues to provide strong leverage for corporate research expenditures in the corporate budget competition.

For my own company, I can say that the R&D credit was of substantial value in helping us to maintain and increase our research and development investments despite the economic downturn in the country. The result was a better foundation for Hewlett-Packard to emerge from the recession with new products that since have fueled a new round of growth—and, just as important, a new round of job creation.

Top management at Hewlett-Packard and at every other high technology electronics company are now well aware of the benefits of the R&D credit. But that awareness was not achieved overnight. One must keep in mind in considering various surveys and other academic studies of the R&D credit that any studies completed to date must be based on very early experience with the credit and thus may not reflect the full integration of the credit into corporate decision-making. The credit was enacted in August of 1981, and hence probably was not taken fully into account in corporate budgeting until 1982, affecting research decisions made for 1982–1985. The credit now has become a significant factor in corporate budgeting decisions and in the crucial decisions as to whether to proceed with particular long-run R&D projects.

The R&D credit directly addresses the corporate budgetary bias toward cutting into long-term programs in favor of the short term. While R&D expenses, unlike investments in plant and equipment, are a direct hit to the corporate bottom line in the year in which they are incurred, the R&D tax credit provides a corresponding direct benefit to the company's earnings in the year of the increased R&D expenditure. Because of this direct benefit, a company can spend substantially more on R&D with a smaller financial statement impact than otherwise would be possible. If, prior to enactment of the credit, a company spent an additional $10 million on R&D projects, the increased expenditure would decrease after-tax earnings by $5.4 million. By contrast, upon application of the credit (assuming that the R&D expenditures are qualified and incremental), the financial statement impact is reduced to approximately $2.9 million. That is a major difference to those senior corporate managers concerned about earnings per share. The R&D credit can, and does, encourage investment in the longer-term, otherwise marginal R&D projects.

Moreover, the benefits of the credit are returned to the R&D function. Indeed, at many high technology electronics companies, including Hewlett-Packard, the increased investment in R&D has greatly exceeded the amount of credit for any particular year.

The problem now is that the temporary nature of the R&D credit is distorting current R&D investment decisions. Many major R&D projects have a cycle of five years or more with the greatest dollar amounts of cost coming toward the end of the cycle. Thus, for those projects that would be undertaken now in response to the R&D credit, a substantial portion of the R&D costs will be incurred in years after 1985, a point at which the R&D credit currently is scheduled to lapse. Before undertaking a project and at each of the numerous "milestones" in the cycle of a project, a determination will be made whether the research effort is worthwhile. If the tax incentive embodied in the R&D credit disappears, or if continuation of the credit seems problematic, the company's assessment of the financial risk likely will become more adverse and could lead to termination of some projects.

Even now, the R&D credit is becoming less of a factor in corporate decision-making. Prudent management will not rely on an incentive that has slightly more than one year of life. Having enacted the R&D credit and thereby having encouraged companies to incur R&D risks which they otherwise might have been unwilling to incur. Congress should not reverse this R&D incentive by allowing the credit to lapse. The R&D credit must be made permanent as soon as possible to sustain its incentive effect.

The R&D Credit As A Tax Reduction Measure. We believe that the R&D credit also has been successful in achieving its second objective of providing a tax reduction to the high technology sector of our economy which bears a disproportionately high tax burden in an intensely competitive world market. Last year Hewlett-Packard, along with 19 other companies from the high technology electronics industry, participated in a study of the effect of the federal tax system on the industry. This study found that, taking into account the tax law changes enacted in 1981 and 1982, the combination of many characteristics of high technology electronics companies—the existence of rapidly obsolete equipment, substantial investments in R&D, large operations overseas, few debt-financed investments—converge to make the U.S. corporate tax burdens faced by these companies very high relative to other industries. This analysis has been confirmed by a Joint Committee on Taxation study on effective tax rates which indicates that in 1982 effective tax rates in the high technology electronics industry were 40 to 60 percent higher than the effective tax rates of the corporate community generally. Our study found that if the R&D credit had not been in existence, the effective tax rates in our industry would have risen 10 to 20 percent above their already disproportionately high levels. Thus, the R&D tax credit has been an efficient mechanism for reducing the tax burdens of high technology companies which must constantly search for sources of capital for expensive R&D activities.

CHANGES IN THE STRUCTURE OF THE CREDIT

Finally, I would like to address briefly a number of technical criticisms which have been made with respect to the R&D credit.

First, the credit has been said to be an ineffective incentive because of its limited utility to companies with no tax liability. Some companies may have no tax liability because of their benefits received from other favorable provisions of the tax code. Whether these companies should also receive benefits from the R&D credit is at best unclear. For other companies the question is more difficult. Making the credit refundable would obviously solve the problem, but would add substantially to the revenue loss and would breach long-standing U.S. tax policy principles. Thus, we do not advocate such a change. Instead, we strongly support the provision in the Senate-passed R&D legislation that makes the credit available to start-up corporations, which by definition have no tax liability, and would thereby encourage budding research efforts at the small business level.

Another technical criticism of the current R&D credit has been that the incremental feature of the credit eliminates any benefit to companies with declining R&D. We agree that feature of the current credit is not fully desirable. But eliminating this feature inevitably produces other difficulties. The credit can only be an effective incentive if it, first, provides a substantial level of incentive (*i.e.,* through a relatively high credit rate) and, second, applies to marginal corporate R&D decisions (*i.e.,* to decisions to undertake R&D projects which without the credit would not be undertaken). Given these requirements, the only way for the credit to be a effective incentive for all taxpayers is for it to apply a high credit rate to all current year R&D expenditures (without regard to prior year levels). Such a high rate, non-incremental credit would cause substantially expanded revenue costs. On the assumption that this result is not fiscally permissible at least in the short run, the real question is what compromises must be made to reduce the credit's revenue loss.

In 1981 Congress decided that the revenue loss ought to be reduced by enacting a tight three-year base period calculation. The impact of this decision is to eliminate the credit incentive for those relatively few taxpayers whose R&D is declining but to provide the full incentive for the many taxpayers which are increasing their R&D over prior periods. We supported that decision in 1981 and continue to support it now. However, we would be pleased to discuss changes in the base period if this Subcommittee concludes that the full incentive effect of the credit ought to be extended to companies with declining R&D.

A third technical criticism is that the credit may have a limited incentive effect from a time-value-of-money perspective because each dollar of current year R&D is applied to the base period against which R&D in each of the following three years is measured to calculate the incremental credit. While this analysis may be essentially correct from an academic economist's perspective, we believe the impact is overstated because of the different nature of the corporate budgeting and decision-making process which relies on more of a cash flow approach, examining the effect of expenditures on earnings as calculated for financial reporting purposes. Under financial accounting rules the credit today is, and no doubt always will be, treated in full as a tax reduction in the year in which it is earned, which is the year of incremental R&D expenditures, without regard to the fact that such R&D expenditures could reduce the taxpayer's future R&D credit by increasing its base period expenditures.

Nonetheless, it would obviously be better if this feature of the credit could be mitigated. CBEMA and other electronics company groups have studied various alternatives to accomplish this result. Unfortunately, we have not found any likely alternative solution which does not involve a significant additional revenue loss or serious technical problems. Nonetheless, if the Subcommittee wishes to consider these alternatives, we would be glad to discuss them with you.

In sum, it can be said that all of these technical criticisms result essentially from Congress' efforts in 1981 to keep to a minimum the revenue loss from the credit. They do make the credit less of an incentive, at least for some taxpayers, than it potentially could be. But they do not alter our fundamental conclusion that for most companies the credit in its present form, has been and can continue to be an effective incentive.

A question also has been raised as to whether a tax credit and a deduction should be available for the same research expenditures. In this regard, some have suggested the possibility of a so-called "basis adjustment"—really a deduction disallowance—under which the deduction for R&D expenses for a particular taxable year would be reduced by the amount of R&D credit claimed in that year. However, we believe that the issue here should not be whether some "double benefit" exists for R&D spending. Rather, the proper question is what level of incentive do we wish to have for R&D activities. For corporations, any deduction disallowance has the same impact as a reduction in the R&D credit rate by 46 percent because deductions in an amount equal to the credit are lost, increasing tax liability by 46 percent of the amount disallowed (*i.e.,* the amount of the credit). Thus, a full deduction disallowance to the extent of the credit is the economic equivalent of reducing the credit rate from 25 percent to 13.5 percent. Such a rate reduction would substantially undercut the incentive effect of the credit.

Finally, we recognize that the credit can be improved by modifying the definition of qualified research to better target the credit to the purposes for which it originally was enacted. We support the revised definition of qualified activity included in the Senate-passed R&D legislation, which we understand addressed Treasury's definitional concerns. Particularly important is that this revised definition clarifies that the development of software for use as products or in production processes generally qualifies for the credit. It is vital that this software issue be promptly addressed to eliminate the present uncertainty under proposed regulations which have caused great difficulty to the industry.

CONCLUSION

We strongly believe that the R&D credit has begun to be an effective tax incentive. But in order to sustain its incentive effect, the credit must be made permanent as soon as possible. While various technical criticisms of the credit can be made and should be given careful review, without a prompt extension the tax incentive for vitally important increases in R&D spending will be diminished as corporate decision-makers decline to base their actions on an incentive which has only months of life remaining.

We urge that this Subcommittee recommend to the full Ways and Means Committee that the credit be made permanent and that legislation to accomplish this result be enacted as soon as possible.

R&D INVESTMENT INCENTIVES IN SELECTED COUNTRIES

CANADA

1. Current and capital expenditures for R&D are deductible in the year incurred. Indefinite carryforward.

2. 1978–1979 deduction in addition to 100% write-off, equal to 50% of the "incremental" R&D in a given year. Both current and capital expenditures included. Three prior years used as base.
3. Direct grants available.

GERMANY

1. Current R&D expenses deductible in the year incurred.
2. Direct grants available.

FRANCE

1. For buildings used for R&D 50% depreciation in first year.
2. Current R&D expenses deductible in year incurred.
3. 25% R&D tax credit for incremental R&D expenditures.
4. Direct grants available.

JAPAN

1. Current R&D expenses including outlays for fixed assets deductible in year incurred.
2. 20% R&D tax credit for incremental expenditures.
3. Direct grants available.

UNITED KINGDOM

1. Capital R&D expenses deductible in year incurred.
2. Capital R&D expenditures receive 100% writedown allowance.
3. Direct grants available.

UNITED STATES

1. Current R&D expenses deductible in year incurred.
2. 25% R&D tax credit for incremental R&D expenditures.
3. More rapid write-off for capital R&D expenditures but reduced ITC.

ATTACHMENT 4

	United States	Australia	Belgium	Canada	Denmark	France	Germany	Ireland	Italy	Japan	Netherlands	United Kingdom
Immediate deduction for R&D expense excluding capital assets.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes.
Immediate deduction or special accelerated depreciation for R&D capital assets.	Yes	Yes[1]	Yes[2]	Yes	Yes	Yes[7]	Yes[9]	Yes	Yes[10]	No	No	Yes.[13]
Direct grants	No	Yes	Yes	Yes[5]	No	Yes	Yes[9]	Yes	Yes	Yes	Yes	Yes.
Foreign tax credit not reduced by R&D (Regs. § 1.861–8).	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes.
Cheap loans	No	No	Yes	No	No	No	No	No	No	Yes	Yes	Yes.
Special tax credits	Yes	No	No	Yes[4]	No	Yes	No	No	No	Yes[11]	No	No.
Deduction for payments to research institutes.	Yes	Yes	Yes	Yes	?	Yes	Yes	Yes	?	Yes	Yes	Yes.
Exemption from withholding tax on foreign loans used to finance R&D.	No	No	Yes	No	No	No	Yes	No	No	No	No	No.
Property tax exemptions on R&D facilities	No	No	Yes[3]	No	No	No	No	No	No	No	No	No.
Tax exemptions for R&D businesses	no	No	Yes[3]	No	No	Yes[8]	No	No	No	No	No	No.
Gains on disposition of R&D capital assets exempt.	no	no	Yes[3]	No	No	No	No	No	No	No	No	No.
Subsidy for R&D employment	No	No	Yes	No	No	No	No	No	No	No	Yes	No.
Tax deductible R&D investment reserve	No	No	No	No	Yes[6]	No	No	No	No	Yes[12]	No	No.

[1] 3-yr. 150 percent declining balance depreciation on R&D equipment; 3-yr. depreciation on buildings.
[2] 3-yr. declining balance depreciation for R&D equipment; a choice of double the ordinary straight-line on buildings or the generally available double declining balance method.
[3] In economic "development areas."
[4] 10 percent investment tax credit plus 150 percent deduction for R&D expense in excess of average at last 3 years.
[5] 50 percent grant of amounts invested in R&D.
[6] Up to 25 percent of profits.
[7] 50 percent first-year writeoff.
[8] If technical personnel own 40 percent or more of the R&D business, it is tax exempt.
[9] 20 percent subsidy up to DM 500,000—7.5 percent on excess. These subsidies replace special accelerated depreciation which was available in 1975.
[10] 50 percent in first year, balance capitalized if project successful. If unsuccessful, balance written off in ext year.
[11] 20 percent of excess of R&D expenditures over those in the highest year since 1967.
[12] If related to overseas market development, small firms may establish a tax deductibility reserve which is restored to income over 5 yr.
[13] 100 percent first-year writeoff.

MEMBERS OF THE COMPUTER AND BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION

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HEWLETT · PACKARD COMPANY
3000 Hanover Street Palo Alto California 94304

JOHN A. YOUNG
PRESIDENT AND
CHIEF EXECUTIVE OFFICER

September 14, 1984

The Honorable Charles B. Rangel
Chairman, Subcommittee on Oversight
Committee on Ways and Means
1101 Longworth House Office Building
Washington, D. C. 20515

Dear Chairman Rangel:

At the August 3, 1984, hearing before the Subcommittee on Oversight, you requested certain additional information concerning the Research and Experimentation Tax Credit. We are pleased to respond to this request.

Hewlett-Packard Company (HP) is a major designer and manufacturer of precision electronic equipment for measurement, analysis and computation. HP makes over 6000 products that have broad applications in the fields of science, engineering, business, industry, medicine and education. Principal product groups include computers and computer systems, handheld calculators and computer/calculator peripheral products; test and measuring instrumentation and solid-state components; medical electronic equipment; and instrumentation for chemical analysis.

HP's annual sales in fiscal 1984 are expected to exceed $6.0 billion. HP employs more than 80,000 people worldwide with over 60,000 U.S. employees. Turning specifically to the Subcommittee's questions:

Question 1: Whether your firm and/or association members claimed the research tax credit. If so, a) for what year(s), and b) in what amount(s)?

HP claimed the research tax credit as follows:

Year Ended October 31	**Amount** $ Millions
1981	6
1982	16
1983	25
1984 (est.)	26

Question 2: The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product, and

Question 3: The final product or process to be affected or created.

HP has claimed the credit for a great variety of research activities. A major part of HP's research effort is in the area of basic and applied research. Nearly twenty years ago HP created our corporate laboratory, HP Labs, which is devoted entirely to high-risk projects of long duration, including the following projects:

1. Materials research - Investigation of the electrical, optical and magnetic properties of physical materials.
2. Components - State-of-the-art semiconductor and fiber optics research.
3. Medical electronic equipment in the area of non-invasive, real-time diagnosis and monitoring of patients.
4. Analytical instrumentation, including laser spectroscopy and super-critical-gas separation methods.
5. Electronic test instrumentation emphasizing the synergism between computers, computer networks, and smart instruments.
6. Computation - including new central processing unit architecture, activities directed towards high-level, object oriented computer languages and studies of speech waveforms leading to new systems for both speech recognition and speech synthesis.

In its fiscal year ended October 31, 1983, approximately fifteen percent (15%) of HP's qualified research expenditures were incurred by HP Labs.

HP's research effort is also directed to applied research and the development of new products. New product introductions are essential to the life of a high technology company. More than two-thirds of HP's estimated fiscal year 1984 sales of $6 billion will have been for products introduced since the enactment of the R&E tax credit in 1981.

Question 4: If the credit had not been available, a) the specific product or experimental activity that would not have been undertaken, b) whether such activities would have been deferred to the future or never undertaken, and c) the resulting amount of reduction in overall research spending, and

Question 5: The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

> At the time of enactment of the research tax credit, HP chose not to directly target the benefits of the credit to any particular research project.
>
> Besides HP Labs, HP has more than forty U.S. divisions, all of which perform research activities, the 1983 research expenditures of many of these individual divisions exceeded $20 million. Research budgets are established for the company as a whole and within each division. The R&E credit was a significant factor in settling these budgets in the past three years. As I mentioned in my testimony, the increase in our R&E spending from 8.7 percent to 10.5 percent of sales from 1980 to 1983 was a conscious management decision after reflecting on the benefits of the tax credit. Our decentralized approach to research makes it impossible to determine which specific product or experimental activity was undertaken as a result of the credit.
>
> I would be misleading you to say that specific research activities were undertaken "primarily because of the tax benefits available under the credit." It is clear, however, that the credit has become a significant factor in corporate budgeting decisions and in the crucial decisions as to whether to proceed with long-run, high risk R&E projects.

Question 6: The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

> In claiming the research credit, all of the expenditures reported by HP as "qualified expenditures" except for cash profit sharing wages paid to R&E personnel were included as research costs in reports to the SEC.

Question 7: If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

> The temporary nature of the credit is its greatest drawback. Major R&E projects have a cycle of five years or more, with the greatest dollar amounts of cost coming toward the end of the cycle. Even now, the credit is becoming less of a factor in our decision-making. Making the credit permanent would restore its incentive impact and directly impact the size of HP's long-term research budget and planning.

Question 8: If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

> It is unlikely that the suggested "narrowing" of the definition of qualified research expenditures would affect HP's research activities because all of HP's research activities would qualify under the more restrictive R&E definition.

I appreciate this opportunity to reemphasize the importance of the R&E tax credit to HP and the electronics industry. If you should require any additional information, please let me know.

Best regards,

John Young

John A. Young

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

  (a) for what year(s), and

  (b) in what amount(s)

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

  (a) the specific product or experimental activity that would not have been undertaken,

  (b) whether such activities would have been deferred to the future or never undertaken, and

  (c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

IBM'S RESPONSE TO CHAIRMAN RANGEL'S REQUEST FOR ADDITIONAL INFORMATION ON THE R&D TAX CREDIT

(1)(a)(b)	1981	$ 29 million
	1982	$112 million
	1983	$164 million

(2) In 1983, IBM spent a record $3.6 billion, worldwide, on research, development and engineering, bringing our investment in these areas to about $16 billion over the five years 1980-1984.

The company maintains two research laboratories in the United States -- in Yorktown Heights, New York, and San Jose, California. These laboratories carry out fundamental research in the physical, mathematical and computer sciences, and explore advanced technologies in such product-related fields as microelectronics, information storage, systems architecture and telecommunications. A growing amount of research is also conducted in collaboration with universities, on problems which are of academic as well as industrial interest.

In addition, IBM operates 25 development laboratories and major programming centers in the United States. Their activities range from advanced semiconductor logic and memory technology to the development and engineering of a wide range of information handling products and programming support.

All of the foregoing activities have been considered in the calculation of "qualified expenses" for which the tax credit has been claimed.

(3) IBM's operations, with minor exceptions, are in the field of information handling systems, equipment and services. We produce, for our own use, some of the industry's most advanced microelectronic components, circuit packages and other devices. Our end products range from typewriters and office copiers to personal computers, intelligent workstations, small business systems, and intermediate and large "mainframe" computers. They also include a wide range of input/output and telecommunications equipment, data storage devices, and systems and applications programming, and robotic systems.

(4) Proprietary considerations make it hard to be specific about activities that IBM would not have undertaken or would have deferred, since 1981, if the R&D tax credit had not been available.

IBM's R&D resource allocations are part of the company's Operating Plan. The "D" portion (which is much larger than the "R") represents the sum of all development work justified by the business cases for all the products in our plan, bearing in mind the before- and after-tax effects of additional R&D activity. Certainly, at this point, the presence or absence of a tax credit does influence the decisions management makes on business cases that are marginal from a financial standpoint, but, nevertheless, are technologically or functionally attractive.

In contrast to the commercial development of technologies and products, scientific and engineering research is aimed at expanding the art of the possible by exploring potentially valuable, but high-risk ideas, whose payoff is both distant and uncertain.

Typically, research investment is based more on management's business judgment than on computed economic return, and its influenced more by past experience with technology transfer than by external factors. Even so, the availability of a tax credit does help encourage more research to be done in any given situation.

The credit would be even more effective if industry knew that it would continue to be available, for continuity is an absolute requirement for an aggressive R&D program. It take time to develop the skills and the programs to bring about wholly new capabilities.

(5) Again, it is hard to identify specific activities which were undertaken primarily because of the tax benefits available under the credit. Yet, the credit has been influential in intensifying IBM's level of effort on on-going R&D projects, encouraging research work to be performed in the United States, and stimulating increased IBM support of university research through grants, loaned talent and equipment.

Since 1981 when the ERTA was enacted, IBM has sharply increased its R&D spending, and the tax credit was a significant factor in this decision. In 1982 and 1983, our R&D grew more rapidly than our revenue, and we expect this to be true for 1984 as well. By year-end, we project that the three-year compound growth rate for IBM's R&D will be more than double the rate for the previous five years.

IBM's cooperative research with U.S. universities has grown rapidly in recent years, to the point that more than 910 projects have been initiated -- over 460 of which are now active with 135 different institutions, representing a current multi-year IBM commitment of over $90 million.

Clearly the tax credit has been a positive influence to invest more in R&D, in all its forms.

(6) Additional "qualified" expenditures include other engineering and software expenses.

(7) Making the R&D tax credit permanent would encourage further increases in research and development investment by providing assurance of steady support on which companies can depend in their long-range planning. R&D is not an activity which one casually turns on and off. Projects are not normally completed in a single year, three-to-five years of work on a new manufacturing process or project is not uncommon. Obviously, the assurance that we are not faced with an "on-again, off-again" tax policy would encourage the planning of such programs and the multi-year financial commitments they represent. The R&D tax credit should be extended now so that its benefits can be considered in the decisions being made today on new programs involving major funding well beyond 1985.

(8) Any reduction in the credit would necessarily influence management decisions regarding the business cases for proposed research and engineering projects by adversely affecting the anticipated before- and after-tax results. Excluding development activities, in particular, from the definition would seriously undermine the tax credit's effectiveness as a stimulant to innovation and productivity.

The development of scientific discoveries into innovative new products, designed for low cost, high quality manufacturering, is cental to U.S. industry's ability to remain competitive on an international scale. This is true not only of "high tech" companies like IBM, which compete in a tremendously dynamic marketplace, but of historically more stable-paced industries in which overseas competitors are rapidly applying automation and information technology to upgrade their productivity and products.

Chairman Rangel. Mr. Krowe.

STATEMENT OF ALLEN J. KROWE, SENIOR VICE PRESIDENT, FINANCE AND PLANNING, INTERNATIONAL BUSINESS MACHINES CORP.

Mr. Krowe. Thank you, Mr. Chairman and members of the committee. I appreciate the opportunity to express IBM's views on the research and experimentation tax credit. In summary, my testimony is that this credit has been a significant motivating factor to increase IBM's research and development efforts.

I am part of the IBM management team responsible for allocating IBM's valuable resources in an effective and efficient manner in a very competitive industry. This competitive industry is based on the ability of a company like IBM to invest in R&D and produce products which are accepted by our customers and which, in turn, generate revenues, profits and tax payments.

From 1980 through 1984 IBM will have invested about $16 billion of its own funds in R&D, or about 8 percent, as I understand it, of the total for all private funding by industry in the United States.

For 1982, 1983, and 1984 the presence of the R&D tax credit was a significant influence on our decision to allocate additional resources to R&D. In those 3 years, we grew R&D at a more rapid rate than our revenues and more than twice the growth rate of the previous 5 years. The amount by which our R&D spending exceeded our revenue growth was approximately $350 million and the increase in R&D spending over the previous 5-year growth rate amounted to approximately $2.5 billion. All things being equal, when a major expense area grows more rapidly than one's revenues, the effect will be to decrease before- and after-tax profit margins. The presence of the R&D tax credit helped to ameliorate this impact on after-tax profit margins and was a positive incentive to spend more on R&D.

In IBM's case, from 1973 through 1980, our increase in R&D averaged about 10 percent per year. In 1982, the first full year that the credit was in effect, IBM's increase over 1981 was greater than 24 percent. In 1983 and 1984, the R&D growth rate will average over 20 percent. This growth rate is significantly higher than our growth rate in revenue over the same 3-year period.

In our industry and in most R&D operations, there are always more R&D opportunities than can be funded in a sound and balanced manner. When revenues are projected to grow, that can have a positive effect by allowing R&D to grow and, therefore, fund some of these additional projects. To allow R&D to grow faster than revenue, one must consider the before- and after-tax consequences of the additional expenditures.

It seems clear that our company and, I believe, most high-technology companies are positively motivated by the credit to undertake additional R&D beyond what would ordinarily be funded.

It is exceedingly rare that an R&D project can be concluded in a single calendar year. In many cases, the projects undertaken will take 3 to 5 years to completion. The incentive provided by the tax credit to undertake additional projects in year No. 1 are then followed by R&D investments to complete the projects in years 2 through 5. The new projects in year 1 add to the base in subsequent years. This multiplier effect of the incentive on additional spending in future years further enriches the effect of this tax credit on our economy.

It is important to understand that in industry the basic purpose of investing in R&D is to produce products, goods, and services which are accepted by our customers and produce revenues, profits and, I might add, additional taxes. Using overall averages for our business for each additional R&D dollar, we plan to generate $11.20 in additional revenues. Based on our present before-tax profit margins, this would result in additional Federal income taxes or $1.29. Accordingly, the effect is that we expect to return to the Government in additional taxes more than five times the value of our R&E tax credits.

Comparing the increase in R&D expenditures relative to the tax revenue loss in the same fiscal year seems to have very little economic validity and is certainly misleading. In 1983, IBM paid the U.S. Treasury almost $1.4 billion or about 3 percent of the total Federal corporate income taxes. For the period 1981, 1982, and 1983, these payments to the Treasury totaled $3.3 billion.

Should the R&D tax credit be allowed to expire at the end of 1985, we estimate that in 1986 IBM's tax payment will be about 5 percent greater than it would have been prior to the passage of the combined 1981, 1982, and 1984 Tax Acts. It is ironic that the high-technology industries which are so nurtured by other countries, particularly Japan, stand on the brink of being worse off in 1986 than they would have been before all the tax legislation which is so widely thought to be beneficial to industry.

If the R&D tax credit is not extended beyond 1985, and in light of the overall added burden of taxation from the 1981, 1982, and 1984 tax bills, it is clear that our spending on R&D will be diminished.

I urge this committee and the Congress to take the appropriate action soon to at least extend this worthwhile incentive for 5 years so that we can accelerate further this important investment in economic growth, employment, and improve our country's international competitive edge.

Thank you.

Chairman RANGEL. Thank you.

[The prepared statement follows:]

STATEMENT OF ALLEN J. KROWE, SENIOR VICE PRESIDENT FOR FINANCE AND PLANNING, INTERNATIONAL BUSINESS MACHINES CORP.

The House Ways and Means Subcommittee on Oversight is commended for addressing the subject of the Research and Experimentation Tax Credit as R&D is a vital national issue. IBM has always recognized that the success of our company depends on vitality of our basic research and the competitiveness of our technology in markets both here and abroad, along with other things such as the quality of mathmatics, science and professional education which provide the important human resource of our business. The public and the Congress have long been interested in the nation's scientific research, development and productivity. Lately the ability of U.S. companies to compete with Japanese and other foreign companies has become of prime importance. There is now widespread consensus that R&D and math, science and engineering education, the roots of our economic prosperity, have been neglected and are critical to the job of rebuilding our economy.

IBM supports making permanent the tax credit for increasing research and development activity. The credit serves as an effective incentive to increase the growth of R&D and the economy. It is an important measure in maintaining our nation's economic health and keeping U.S. companies competitive in the world markets. Rightly, its emphasis is on *growth* which is achieved by fostering R&D projects which otherwise might not be financially attractive. It was also enacted to make our tax system more equitable by encouraging investments in technology development in the same way that ACRS and the ITC has promoted investments in plant and equipment.

THE IMPORTANCE OF WORLDWIDE COMPETITION

Because of the importance of semiconductors and computers, worldwide competition in the two industries is increasing with both the industrial and the developing nations recognizing the fundamental importance of viable domestic capabilities.

With Government initiatives, especially in Japan, Canada, France, Germany, and England, the knowledge base of these technologies is spreading worldwide and being augmented by the contributions in research, development, and manufacturing that these nations are making.

The United States no longer has an undisputed lead in these two industries. In fact, in specific industry sectors, such as memory devices, calculators, and displays, the USA has lost its preeminence.

In 1971, the United States suffered its first balance of trade deficit since 1897. Since then, deficits have been persistent and large. If we are to retain our leadership position and recapture a healthy trade position by correcting our more serious balance of payment deficits, it is essential that we spend more on R&D and educate ever-increasing numbers of Americans in the fields of math, science and engineering.

PRODUCTIVITY

One of the key determinants of the U.S. competitive position is the productivity of its labor force. During the 1970s, the growth in labor productivity of the private economy showed a decline. The average annual growth rate of the private sector's productivity—measured by private GNP divided by the number of hours worked—fell from 2.93 percent during the 1960s to 1.63 percent during the 1970s. By 1983, the productivity growth in our country had partially recovered to 2.3 percent. While the causes of the measured decline are diverse and complicated, the decline underscores the need for industry to invest in more efficient and productive capital and technology to ensure a growing standard of living for the country.

Comparing productivity growth across countries also highlights the need for the U.S. to keep investing in new techniques. The productivity gains of countries such as Japan, Germany, and France have in recent years outpaced those of the United States. In the 1960s through the 1970s the average increase in Real Gross Domestic Product per person employed—was 6.88 percent for Japan, 3.66 percent for Germany and 4.11 percent for France. The comparable annual growth rate for the United States—real GNP divided by the number of civilians employed—was 1.43 percent for the same period. The high figures for the other countries are at least partially a function of the fact these countries were in a different stage of economic development than the United States. However, they underscore the fact that the United States is operating in an increasingly competitive environment. In order for the country to compete successfully in this new era, the Government must have the correct tax incentives to ensure that the nation's economy allocates its resources in the most efficient way possible.

ROLE OF RESEARCH AND DEVELOPMENT

In order for the high technology sectors to continue to advance, research and development efforts must be expanded, and qualified technical professionals must also be made available to industry and academia.

On both of these counts, the United States is falling behind its world competitiors. U.S. R&D spending as a percent of GNP has dropped from 3 percent in 1963 to about 1.9 percent in the 70's and will be about 2.7 percent in 1984. In the same time frame, Japan's R&D went from 1 percent to 2.3 percent and West Germany's from 1.25 percent to 2.6 percent.

While U.S. R&D spending in total dollars remains the highest in the world, the gap narrows considerably if defense R&D spending is excluded. Also, government spending by Japan and European countries is heavily targeted on high technology areas such as the semiconductor and computer industries.

With regard to education, the U.S. has been overtaken by Japan in the number of electronic and electrical engineers generated annually. This discipline is a basic one for most high technology industry sectors, especially semiconductors, computers and the telecommunications industry.

Notwithstanding the importance of Federal laboratories and universities, private industry is the dominant force in American science and technology. About 70 percent of R&D activity in the United States, as measured either by funds expended or by scientists and engineers employed in R&D, takes place in industry. Over half of all U.S. R&D comes from private industry funding.

Last year, IBM spent a record $3.7 billion on research, development and engineering. We will have spent about $16 billion in the U.S. alone over the years 1980–1984 . . . with accelerated growth in the later years.

Barely 30 years old, the U.S. information industry continues to growth at almost 15 percent a year, creating tens of thousands of new jobs annually. More important, this industry introduces new technology so rapidly that each year its products deliver about 25 percent more in price performance for their users in other industries at no increase in cost.

High technology companies, such as IBM, differ in many ways from traditional manufacturing companies. Our company competes in a tremendously dynamic marketplace and therefore *must* invest a major portion of its resources in research and product development in order to survive and prosper.

Among the 20 member companies of an Ad Hoc Electronics Tax Group formed last year to review the effect of tax systems on U.S. electronic firms, investments in R&D ranged from 6 to 15.8 percent of sales revenues in 1982, when R&D spending for U.S. industry as a whole as only 2.4 percent of sales. In 1983, R&D spending as a percent of sales grew to 2.6 percent for all industrial sectors.

Yet, even the historically more slow-paced industries (including some with the incorrect designation "sunset industries") are today challenged by rapid technological change, for the new industrial technologies of automation and information management can be used—and are being used by overseas competitors—to upgrade both productivity and product at a rapid pace. Government actions can have a dramatic effect, either positively or negatively, on this process.

Federal policy areas that may have a direct impact on industrial R&D include not only overall fiscal and monetary policy but changes in patent policy and other incentives to stimulate private returns on innovation, support of research and graduate study in engineering and scientific institutions and improved Government procurement criteria and practices.

For U.S. industry to remain competitive, it is important to address both the education and the research problem. Industry, together with the academic community, must take the necessary steps to assure a continuous flow of professional skills and a continuous investment in research and development. The Government should support this effort by extending the incremental R&D tax credit incentive.

U.S. CORPORATE R&D SPENDING

Based on Business Week's 1983 R&D scoreboard, corporate funding of R&D in the United States was up by 9.8 percent last year as large spending gains by computer manufacturers, suppliers of software and computer services, semiconductor makers, electric and electronic companies, chemical producers, pharmaceutical houses and telecommunications equipment firms more than offset recession-trimmed budgets in industries like aerospace, oil field equipment and services and farm and construction machinery. This expansion was not a one-shot increase. Over the 1979-83 period, industrial R&D spending increased by about 70 percent—or more than inflation—even though profits were down during those five years. The renewed commitment of American companies to the development of new technologies and the application of existing ones was also illustrated by a higher ratio of R&D expenditures to sales. After remaining stuck at the 1.9 percent level in the late 1970s, R&D spending as a percentage of sales is predicted to be about 2.7 percent in 1984.

R&D spending by Japanese industrial corporations also increased by a hefty margin during the five years through March 1984— perhaps by a factor of two, including a 13.4 percent rise in FY 1983 according to Nihon Keizai Shimbun calculations. Japanese R&D budgets actually expanded at a faster pace during this period than sales, in part because of rapid advances in technology and escalating research costs. However, Japanese research directors point out that the renewed emphasis on R&D in the United States and the growing reluctance of American corporations to license leading-edge technologies to their competitors in Japan have also spurred spending, which expanded as a percentage of sales from roughly 1.8 percent in FY 1979 to 2.3 percent in the fiscal year just ended.

Japanese companies in the electric equipment and electronics field (including makers of computers and other office equipment, semiconductors, telecommunications equipment, consumer electronics products, appliances and heavy electric machinery) and in the automotive industry have traditionally financed over half of Japanese corporate outlays. Nihon Keizai's list of the top ten firms in R&D spending highlights the pivotal role to these two groups of companies. While the R&D leaders in the United States span a range of industries, nine of the ten biggest Japanese spenders are either electronics makers or automotive manufacturers. In addition, MITI in a press conference in June stated that Japan should push ahead with development of innovative frontier technologies to maintain its economic strength and called for government/industry cooperation to that end. Cited as the frontier technologies for this continued policy push were micro-electronics, biotechnologies, new materials and telecommunications along with certain government projects such as new communications media and "technopolis" . . . the high-technology industrial centers.

In this connection, MITI is considering a new law to promote R&D in the innovative technologies for the 21st century, including further financial measures to help private firms accelerate R&D activities. This must be contrasted with the U.S. where we are facing a sunset for the U.S. R&D tax credit incentive.

R&D TAX INCENTIVES

The R&D tax credit provison of the 1981 tax act enacted by the Congress to provide a significant incentive to encourage increased R&D spending, thereby enhancing the ability of U.S. companies to remain competitive with foreign corporations in developing new technology.

It was appropriate that the R&D tax credit primarily benefitted high technology companies which typically pay higher taxes but received very little relief and where in IBM's case we were actually penalized by the Accelerated Cost Recovery System.

Three years is a very short time in which to evaluate the long-term effects of any tax legislation—let alone incentives for R&D. However, there is substantial evidence from individual companies like IBM that the incentive has been effective.

Research and development is not a macroeconomic phenomenon; it is microeconomic. Focus should not be on the aggregate R&D spending but on the question: Is the industrial response to the incentive likely to lead to more competitive companies, products and processes? The answer to this question may vary industry by industry and sometimes even on a company by company basis.

For some companies, the right response to competition is *not* more R&D spending but in others it emphatically is. It would be very unfortunate if the Treasury provides tax incentives for R&D in companies with structural obstacles which prevent the R&D from being used profitably. If the tax credit meets its purpose, and results in more R&D in the right places, the U.S. will have less R&D being done where it is wasted and cause the investment to be transferred to places where it is needed. While the *net* R&D in the whole economy might not show dramatic growth, R&D growth in those companies committed to a technology-based strategy for competition will respond significantly. A sector-by-sector industry evaluation is just as appropriate here as it was when evaluating the investment tax credit on a sector-by-sector basis.

In the high technology industry, R&D spending was surprisingly strong in 1982 and 1983. The fact that many companies increased their R&D in a period of falling revenues and profits, suggests that the credit had a significant influence.

The incremental R&D tax credit puts the funding design for projects in the hands of the firm spending its own money. While the tax credit is a benefit, it is not a free ride because R&D is costly. For every dollar spent on R&D, a company may spend a multiple of that dollar on manufacturing and marketing. R&D is worth little to a company unless it is exploited in manufacturing and sales where the major expenses are incurred. This is a necessary safeguard which discourages managers from using the Treasury's tax revenues by spending frivolously for R&D.

IBM AND THE R&D TAX CREDIT

From 1980 through 1984 IBM will have invested about $16 billion in R&D. From 1973 through 1981 IBM's increase in R&D averaged about 10 percent per year. In 1982 IBM's increase in R&D over 1981 was greater than 24 percent, or 2½ times the average of 1973-1980 period. In 1983 and 1984 our increase will average over 20 percent. Financial management has made it clear that there are incentives for increasing R&D and that IBM is now operating in a different environment.

In our industry and in most R&D environments there are always more opportunities than can be funded in a sound and balanced manner. When revenues are projected to grow, they can have a positive effect by allowing R&D to grow and fund some of these additional projects. To allow R&D to grow faster than revenue, one must consider the before and after tax consequences of the additional expenditures. The R&D credit is a principal incentive for ameliorating the impact on after tax profit margins of a more rapid growth in R&D. This fact has positively motivated IBM to undertake additional R&D.

The statistics suggest that the credit increases R&D expenditures because R&D expenditures as a percent of sales increased in most U.S. industries during 1981, 1982 and 1983. This conclusion has been rejected by some as there is no complete systematic study to prove any direct linkage. Had the statistics shown a decrease, these same critics would likely have seized it as evidence that the R&D credit had not been effective. Some early surveys on the effect of the credit have been made. However, there is no specific indication of "who was surveyed" at the various selected companies. IBM has no evidence that it participated in these kinds of surveys. Clearly had randomly any number of IBM's development managers been asked the question about the incentive effect of the credit on their development budgets the answer might well have been no effect at all. For IBM, it is simply that the line development manager is not in a position to know what effect the credit has had. The basic resource allocation decisions are made when IBM's operating plan is laid in place. It is at the point in time that the key decisions of recognizing the effects of the R&D credit incentives are made. The credit has motivated IBM to increase its R&D investment in 1982, 1983 and 1984 beyond what it would have been as positive decisions were taken on marginal projects.

As a direct result of each dollar of the tax not paid to the U.S. Treasury because of the credit, IBM invested in excess of $4 over and above the rate of R&D increase for the previous 5 years. It is exceedingly rare that an R&D project can be concluded in a single calendar year. In many cases, the projects undertaken will take 3 to 5 years. The incentive provided by the tax credit to undertake additional projects in year number 1 are then followed by development investment in years 2 through 5. New projects in year 1 add to the base in subsequent years. This multiplier effect of the incentive on additional spending in future years further enriches the effect of this tax credit on our economy.

It is important to understand the basic purpose in industry of investing in R&D, that is to produce products, goods and services which are accepted by IBMs customers and produce revenues, profits and result in additional taxes. Using overall averages for IBMs business for each additional R&D dollar, IBM plans to generate $11.20 in additional revenues. Based on IBMs present before tax profit margins, this would result in additional taxes of $1.29. Accordingly, from an investment by the federal government in a tax credit of 25 cents, IBM expects to return to the government in additional taxes more than five times this amount.

Of course, not all R&D qualifies for the incremental tax credit benefit, and in IBM's case, a little over half (about 55 percent) of our R&D expenditures qualifies for the credit. IBM today must spend for R&D a total of $23 for each $1 of tax benefit. The net additional R&D investment over and above prior funding rates by IBM alone is about equal to the total revenue expenditure by the U.S. government for the 3½ years. IBM believes the facts demonstrate that the credit has had a very positive impact on IBM's investments in R&D.

In discussions of the R&D credit, there is a tendency to compare the increase in R&D spending against the lost tax revenue or that the increase in R&D spending is a measure of the social gain from the credit, while the tax loss is a measure of the social loss. This is not the appropriate comparison. The gains should reflect an estimate of the present value of the increase in the performance of the economy resulting from the increased R&D expenditures over time.

In judging tax policy it is important to remember the virtues of a tool such as the R&D tax credit, which delegates to the marketplace the determination of how it should be allocated. Government must judge this tax measure realistically and should not expect that total R&D net spending in all firms—including the majority who spend little or nothing on R&D—will be stimulated by an incentive designed primarily for innovators such as IBM where the incentive, along with high technology companies generally, has had a very positive effect.

HIGH TECHNOLOGY TAX POLICY

The R&D tax credit is an effective tax policy measure to address concerns about the health of our nation's high technology industries and our new and middle size innovative companies. These innovative, high technology companies will be the keystone of efforts to keep U.S. in a leadership position in world trade, a position on which our future economic prosperity may depend. The tax credit also acts to offset other recent tax measures enacted in our income tax system which have put a higher burden per dollar of income on high technology companies like IBM. The prime example is the Accelerated Cost Recovery System (ACRS) impact on computer equipment. IBM's experience prior to 1981 showed that the true useful life of our computer equipment was five years or less. Under the law applicable in those years, users could write off this equipment under the 200 percent declining balance method (40 percent the first year, 24 percent the second year, 16.4 percent the third year, and 9.8 percent in the fourth and fifth years). In 1981, Congress enacted the ACRS which was designed to greatly speed up cost recovery. For many industries, the effect was dramatically favorable. However, in the case of assets which had established five-year lives or less, there was no shortening of recovery period and the rate of deductions was limited to 150 percent declining balance with a half-year convention (i.e., 15 percent in the first year, 22 percent in the second year, and 21 percent in each of the succeeding years). The 1981 Act contained provisions that would in effect restore the 200 percent declining balance method by 1986. However, with the need for greater revenues in 1982, this promised return to 200 percent declining balance was repealed and the depreciation base was reduced by 5 percent in connection with the investment tax credit. The end result is that users of high technology equipment were distinctly worse off. Again in 1984, the U.S. government in search for additional revenue, further reduced other beneftis available to IBM.

The R&D credit was a provision of the 1981 Ways and Means Committee bill and the final legislation which was included to give some tax relief to high effective tax payers who received limited or no benefits from ACRS and to provide incentive for larger R&D investments needed in the economy. This R&D incentive tax credit has been an important element in trying to balance fairly the tax burden on the high technology industries as compared with other financially profitable businesses.

For 1983 IBM will pay the U.S. Treasury almost $1.4 billion or about 3% of the total federal corporate income taxes. For the period 1981, 1982 and 1983, these payments to the Treasury totalled $3.3 billion. As a company, IBM wants to fund our fair share of the worthwhile and necessary programs of the federal government. We believe in our responsibilities to our society.

However, since the passage of the 1981 tax act, there is a general impression that all corporations in the United States benefited greatly from the 1981 act and have had their tax payments significantly reduced. It's important to understand that when examined in aggregate, the 1981, 1982 and 1984 tax bills have had very little, if any, positive effect on the high technology industry. Should the R&D tax credit be allowed to expire at the end of 1985, we estimate that in 1986 IBM's tax payments will be about 5 percent greater than they would have been prior to the passage of the 1981 and subsequent tax acts. It is ironic that the high technology industries which are so nurtured by other countries, particularly Japan, stand on the brink of being worse off in 1986 than they would have been before all the tax legislation which is so widely thought to be beneficial to business was passed.

CONCLUSIONS

The future of the tax credit as an instrument of Federal policy must be that of the broader debate about what Federal policies are appropriate to stimulate both productivity and innovation in American private companies.

The tax credit is complementary to other forms of direct Federal investment in R&D. Its effects across the entire economy may be relatively modest in percentage terms, and, in the eyes of some, it may not always direct Federal revenues to the specific technologies and specific industrial sectors that would most benefit the economy.

However, it is clearly preferable to the "industrial policy" advocated by some which would specifically direct Federal investment to technologies of economic importance as determined by the Federal Government.

Government should, of course, support the academic, scientific and engineering research that provides the knowledge base and the graduate training on which the private sector depends. Government should also assure the health of both the environment and the process for innovation. But government should not introduce an industrial policy by which it substitutes itself for the more effective private sector process of technology generation. Government officials are too far removed from the short-term vagaries of the marketplace to be sufficiently sensitive to these subtle and ever changing influences. The time needed for Government-directed work to change direction is much too long and would stifle the innovation it seeks to benefit.

IBM believes that the private sector now needs the certainty that the R&D tax credit incentive will be available in the future. The R&D tax credit is an important element in balancing the tax burden on high tech businesses as compared with other profitable industries. It will encourage needed R&D and should not be buried under a mountain of technical criticism.

IBM is convinced that the credit has had a positive effect by encouraging additional investment in research and development and that the R&D tax credit should be made a permanent provision of the U.S. tax code.

Chairman RANGEL. Mr. Ross.

STATEMENT OF IAN M. ROSS, PRESIDENT, AT&T BELL LABORATORIES, REPRESENTING AMERICAN TELEPHONE & TELEGRAPH CO.

Mr. ROSS. Thank you, Mr. Chairman. I appreciate this opportunity to appear. I would like to make five brief points from the viewpoint of somebody who is in R&D, who manages an R&D program and has concern about the future health of this activity. My first point—and it has already been made—is that R&D is important to our national welfare in spurring the economy, in maintaining an international competitive edge—in a broad base of industry not just in high tech industries—and also in enhancing our national security.

Second, despite our magnificent record in R&D, the United Stated needs more R&D. Again, I think it is important that the result of R&D be applied to a wide base of industry. High tech is important to the older industries as well as to the high tech industries.

Third, that the tax credit is a good way to stimulate R&D. I can assure you, Mr. Chairman, that in the case of my company the R&D tax credit has had an effect on the amount of R&D that we do, are doing today—during a period of organizational and financial stress, which as you can imagine, is very difficult. We will provide to you the quantitative information requested on our tax credit and on our R&D programs.

My fourth point is that R&D is inherently a long-term activity. The period from conception to application is long. If you take fundamental advances like the transistor, the laser, the light-emitting diode—or if you watch today the progress from the first breakthroughs on DNA to the emergence of a bioengineering industry—the period from invention to application takes 10 to 20 years. For major new developments, the development period is 3 to 5 years, and for some systems even as long as 8. Thus, then, it seems to me that a useful tax credit has to have a long-term horizon, and should be viewed as being permanent.

My final point is that today and going into the future the R&D process encompasses a very broad range of activity. Software, which has been mentioned, is just as important as hardware, and poses the same kinds of R&D risks. It is very difficult in my company to separate software from hardware. It pervades every product line; it makes many projects possible; it provides the essential flexibiiity that permits us to use the very rapidly developing hardware.

When you have microelectronics doubling its capability every 18 months, you need software to be able to capitalize on that. And indeed, we are designing systems today in which we can interchange hardware and software capabilities as we go into the future.

Finally, the manufacturing processes are vital to our competitiveness internationally, and R&D resulting in new processes should be clearly eligible for credit. Let me give you one example. If you take the well-known 256-K memory, in which on a chip of silicon the size of a fingernail you have 256,000 places where you can store a zero and a 1, the process development, the manufacturing process development, is key to this program.

It is not only a question of can you manufacture this product at a competitive cost. In this case it comes down to the question of can you manufacture it at all. And as I see the rapid trends in technology in this country, and the development overseas, I believe that this manufacturing processing technology will be increasingly critical and urgent to our success.

Thank you.

Chairman RANGEL. Thank you.

[The prepared statement follows:]

STATEMENT OF IAN M. ROSS, PRESIDENT, AT&T BELL LABORATORIES, ON BEHALF OF AMERICAN TELEPHONE & TELEGRAPH CO.

SUMMARY

The Research and Experimentation Tax Credit has been effective in stimulating R&D. AT&T believes that the tax credit should be made permanent and that the application of the law should be clarified in two respects.

The life cycle of most R&D projects requires commitments to spend money for several years before a completed development, if successful, generates new revenues. The time from invention of a major breakthrough to application is, often, a decade; the development period for large, complex systems is 5 or more years. Continuity of the credit and the resultant sustained funding will be essential to the undertaking of many research projects.

There should be no separate restrictions on the eligibility of software costs as set forth in proposed Treasury Regulations. Software R&D should be treated in the same manner as any other research and development since research related to and developments involving software pose the same risks and uncertainties as does work involving hardware. With today's technology a function can often be implemented in either software or hardware; eligibility for a tax credit should not be a factor in these decisions.

While we feel that most post-production costs should not be considered expenditures eligible for the credit, there are instances of changes after the production prototype of an item is completed, or even after it is placed in service, that require further R&D. It should be made clear that, in cases where a post-production process of experimentation necessary to reach an end-result is innovative, costs incurred in such a process should be allowed as qualified research expenditures.

Finally, taxpayer support of university research should be encouraged. University research plays an important role in the welfare of the U.S. in general and the competitiveness of U.S. industry in particular. Such research is important not only for its own sake but also for the contribution it makes to the education of scientists and engineers.

STATEMENT

My name is Ian M. Ross and I am President of AT&T Bell Laboratories. I appreciate this opportunity to appear before you today on behalf of the American Telephone and Telegraph Company and AT&T Bell Laboratories with respect to Section 221 of the Economic Recovery Tax Act of 1981, the Research and Experimentation Credit.

The AT&T entities perform the underlying research, develop, manufacture, and market world-wide information systems and services including telecommunications products. AT&T has a long-established commitment to technical innovation through a vigorous scientific research and development program which we believe is essential to further progress in the information industry and to the general well-being of the nation.

AT&T Bell Laboratories, in particular, has been and continues to be a major source of telecommunications and information systems technology. Today, it devotes substantial research and development effort to fundamental information-age technologies, including micro-electronics, software systems, digital systems, computer systems and photonics. Therefore, we have a keen interest in the Research and Experimentation Tax Credit.

This testimony is in response to the June 4, 1984 press release by the Honorable Charles B. Rangel, Chairman of the Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives. Chairman Rangel and the Subcommittee expressed interest in testimony on eleven specific points concerning the Research and Experimentation Tax Credit: (1) whether the tax credit provisions should be made permanent; (2) whether the credit has the effect of stimultating additional research; (3) what types of research expenditures and industry activities generate the credit; (4) whether the categories of qualifying research expenditures should be expanded; (5) whether taxpayers and the Internal Revenue Service are able to distinguish between activities constituting qualified research and those which do not constitute qualified expenditures; (6) the appropriateness of the base period computation rules; (7) the appropriateness of allowing a credit and deduction for the same expenditures; (8) the impact of the provisions on federal revenues; (9) the impact of the credit on industry spending and allocation of research expenditure budgets; (10) the effectiveness of the current credit in relation to Congressional intent; (11) suggested statutory and administrative changes.

1. The R&E credit should be made permanent

The legislative intent of enacting Internal Revenue Code (IRC) Section 30 (as redesignated by the Deficit Reduction Act of 1984) was to stimulate research and experimentation in the United States. In recent years, foreign competitors such as West Germany and Japan have devoted an increasing percentage of their Gross National Product to R&D. As a result, product development in these countries, in many instances with considerable government assistance, has benefited from ever-increasing technological skill and innovation. Economic progress and national security in the U.S. depend, in large part, on the level of research and development.

New technologies are essential to the strength of this nation's economy because many U.S. companies are engaged in direct competition with foreign entities in both domestic and international markets. Furthermore, because research is by nature a continuing and long-term activity, it is important that the R&E credit be made permanent.

Research findings and the resultant knowledge often provide benefits not anticipated initially. This is dramatically evident in research at AT&T. Telephony evolved from research to help the deaf. The discovery, development, and application of the transistor alone has brought about one of the most significant technological revolutions in modern times: the onset of the information age. More recently, advances in lasers, fiber optics and solar cells have resulted in whole new industries in themselves, and led to advances in telecommunications and other fields such as space technologies, medicine, entertainment and textiles.

Significant technological progress depends on the ability of organizations to plan for a continuing and predictable R&D program. R&D projects often span periods from a decade or more if a fundamental breakthrough is involved to 5–8 years for a complex system. Cosmetic or product differentation projects take a year or less. Longer periods characterize high-technology projects since they frequently involve the development of supporting technologies or novel manufacturing processes or the emergence of a viable market. The natural life cycles of many projects require sustained funding commitments before the completed developments, if successful, generate new revenues.

For example, 18 years elapsed between the conception and the manufacture of an infrared light emitting diode (LED) widely used in lightguide systems; 15 years elapsed for a particular semi-conductor laser (double hetrostructure). The development of our echo canceller provides a dramatic but not unique illustration. The system is used to cancel echoes on satellite and long land-based circuits; it is used extensively by AT&T Communications and is being bought from us by NTT in Japan. The basic algorithm was worked out in 1965; research and experimentation continued and the first prototype was demonstrated in 1976; it went into manufacture in 1979. In this case, an economicially feasible model depended on advances in microelectronic technology.

In addition to direct expenses, a significant investment and an allocation of scarce scientific resources are often required at the outset, again with no assurance that there will be a return to the investor, although benefits may flow to the entire nation and to society at large. During the developmental stages of an R&D project, the tax credit may be the only financial benefit (aside from current deductions under Section 174) that a company receives. Consequently, in order to be able to undertake proper financial and long-range planning, a taxpayer should know whether the tax credit will continue to exist during a particular project's life cycle. A permanent credit is far more valuable and a more powerful incentive than an uncertain one subject to a sunset schedule.

We note that H.R. 4475 (the High Technology Research and Scientific Act of 1983, proposed in the House of Representatives on November 18, 1983), contains a provision making the credit permanent. for the reasons just stated AT&T supports this provision.

2. The credit is effective in stimulating additional research

The credit has stimulated additional research and development expenditures at AT&T. Initially the selection of desirable R&D projects is made through a cost/benefit analysis. At any time there are many attractive R&D projects consistent with the corporate goals. Generally, the number of desirable projects exceeds that which the available resources will support. Ultimately, the decision as to which projects to undertake is based on estimates of available funds. Today, part of these funds come from the R&D credit. Our planning for research thus allows us to initiate certain R&D projects that a reduced research budget, without the credit, would not support.

3. A broad range of research expenditures and industry activities generate the credit

We cannot speak for industry in general; however, we can speak for AT&T whose business includes intercity and international telecommunications services, electronic components, telecommunications equipment, computers, consumer products, business communications systems and government systems. All of AT&T lines of business involve fundamental research, exploratory development and product development—activities that qualify for the tax credit. These activities lead to base scientific knowledge and innovative products and services for broad classes of customers. These products and services result not only in returns to the AT&T shareholders but, by their very nature, in productivity increases to the purchasers.

4. The categories of qualifying research expenditures should be expanded

We believe that there is one area that should be considered for expansion of credit qualification, specifically, depreciation of owned assets; and two areas for which legislative clarification is desirable; viz., treatment of software R&D and development work after production has begun.

a. Depreciation of Owned Assets. Under current law, for purposes of the R&E credit, the eligibility of assets used in connection with R&D depends on whether the assets are owned or leased by the taxpayer. Taxpayers are entitled to take the credit on payments made in connection with leased equipment; however, the depreciation on equipment that is owned is not an eligible expense. The artificial distinction between capital assets that are leased by the taxpayer and those that are owned should be eliminated by including depreciation as an eligible expenditure. H.R. 4475 would eliminate this distinction and future legislation relating to the R&E credit enacted by Congress should do the same.

b. Treatment of Software R&D. It should be clear that software R&D should be treated as any other research activity. The criterion for the eligibility of software R&D should be based on the nature of the product (i.e., is it innovative). The development of new and innovative products and services should be encouraged by the credit, whether they are implemented by means of software or hardware.

Furthermore, many modern systems could be designed to use either software or hardware interchangeably for some functions. The decision on which technical approach (software or hardware) is to be emphasized should be made on the relative benefits, and should not be made according to the differential eligibility for a tax credit.

Under the proposed amendment to Regulation 1.174-2, issued in January 1983, only the costs of developing software the "operational feasibility of which is seriously in doubt" would qualify for Section 174 treatment and hence for Section 30 eligibility. Clearly, a company would not undertake a software project if it did not believe that the project would ultimately lead to operationally feasible software. The proposed regulation is ambiguous. Also, this definition of qualified software is so subjective that it provides little guidance to taxpayers and, in addition, gives much discretion to the Internal Revenue Service. Were this proposed regulation to become final, software could be treated in an irrational manner.

c. Post-Production Development Costs. The mere fact that something can be made in a laboratory and can function there does not mean that a product can be mass-produced or that, once it is commercially produced, the product will function as anticipated and without problems. While we feel that most post-production costs should not be considered eligible expenditures, there are instances after the production prototype of an item is completed, or even after it is placed in service, that further R&D is needed. Two examples from our experience illustrate what I have in mind.

Manufacturing processes for a complex microelectronic chip like our 264K memory chip are quite exacting. It is typical to begin production and to refine the manufacturing process until acceptable performance is achieved. In the meantime, of course, commercial quality chips have been manufactured and probably sold to customers. However, the work necessary to understand and fine tune the porcesses is often as innovative as some of the design work. This innovative work should qualify for the credit.

Another example involves what we call "phased introduction"—a common practice with complex systems that have a high software content such as the AT&T Dataphone II. In a phased introduction, a small number of units are delivered to customers to see if the system functions as intended and to learn what changes should be made to integrate functions that were not originally anticipated but that emerged as real users adopted the novel capabilities of an innovative system to real problems. Again, innovative work necessary to develop the additional functions should qualify for the tax credit.

We feel that, in general, cases where the post-production process of development necessary to reach and end-result is innovative, such costs should be allowed as qualified research expenditures.

5. The Internal Revenue Service and taxpayers are generally able to distinguish between activities constituting qualified research and those which do not constitute qualified research

Both taxpayers and the Internal Revenue Service are generally able to discern qualifying from nonqualifying expenditures. IRC Section 30(d) states that for purposes of the R&E credit, " 'qualified research' has the same meaning as the term research or experimental has under Section 174." Code Section 174 does not define the term.

While regulations under Section 174 do not explain in any great detail the types of expenditures which qualify as "research and experimental," [1] the legislative history for Section 30 provides guidance as to those expenditures which qualify. The House Committee Report, as well as the General Explanation prepared by the Joint Committee, provide additional guidance.

Although the legislative history does not greatly expand on the types of expenditures which are research and experimental, it does elaborate on expenses which do not qualify—among those, routine or periodic cosmetic changes, adaptation of production lines, routine design of molds, dies, tools, etc., pre-production planning of production runs, engineering follow-through and adaptation of existing products to a particular customer's needs do not qualify. These restrictions are reasonably explicit and should allow taxpayers and the IRS to apply the credit to projects which are truly innovative. Nevertheless, a better definition of what does qualify, as opposed to what is excluded, would be helpful.

If the definitions are based, as I believe they should be, on existing and accepted accounting practices such as FASB-2, the decision process would be eased.

6. The appropriateness of the base period computations

A major intent of the current law is to stimulate additional R&D activity. The law permits the tax credit only for those expenditures above the level for a sliding three-year base period. There are cogent arguments for alternative approaches. These alternatives run the gamut from no base period (that is, a credit would be applied to all R&D expenditures), a fixed base period, a sliding base period with a lag, to the current sliding base period. As more experience of the impact of the tax credit is gained, and further analyses are completed, one of the alternatives may emerge clearly as the appropriate one. In the meantime, it is prudent to choose a method which is suitable for later change if that becomes desirable. We believe that the current method with a three-year moving average base is appropriate.

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[1] The regulations do, however, state that expenses for "ordinary testing or inspection of materials or products for quality control or those for efficiency surveys, management studies, consumer surveys, advertising or promotions" are not research or experimental.

A feature of the moving average method is that the taxpayer is induced to increase continually his R&D expenditures. As R&D expenditures increase, the base period amounts likewise increase. Accordingly, taxpayers planning to maintain a constant level of expenditure will generally receive no credit. This method structures the base period computation to assure that the credit does not reward the mere maintenance of a fixed level of research effort.

7. A credit and tax deduction should be available for the same expenditures

A credit and a tax deduction for the same research and experimentation expenditure occur only when a taxpayer is eligible for the R&E credit, that is, the R&D credit, that is the R&D expenditures for the current year exceed the base period amounts. Therefore, the overlap only exists with respect to increased expenditures. Moreover, although expenditures may be eligible for a credit and a deduction one particular year, those same expenditures will be included in the base period during the next three years, and additional amounts will have to be expended for R&D to generate a credit in the following three years. Consequently, the perceived double benefit is mitigated by the increase in the base period amounts.

8. The provisions positively affect federal revenues

Although the immediate effect of the credit provisions is to reduce federal revenue, it would be short-sighted to judge the effect without examining the long-range benefits of the credit. In order for U.S. companies to remain at the forefront of high technology industries and to facilitate those companies' ability to compete in the domestic and international marketplaces, research and experimentation must be encouraged. This will aid in providing long-term growth of the U.S. economy and prevent our economy from lagging. The decline in current revenues should be more than offset by the increase in long-term economic growth which should provide for increased earnings, taxation of those earnings, and therefore increased federal revenues in future years.

9. The credit positively affects industry spending and allocation of research expenditure budgets

Previously, we stated that the determination of our research and development budget is contingent upon how much money the corporation has available to spend in view of specified financial goals. By including the R&D credit in corporate funds available for R&D, additional projects can be undertaken.

10. The current credit is effective in relation to congressional intent

The Joint Committee on Taxation noted on pages 119 and 120 of its December 29, 1981 General Explanation of the Economic Recovery Tax Act of 1981 that expenditures for research and development activities in the U.S. had remained at a stable level during the period 1968–1979. However, as a percentage of gross National Product, such expenditures had dropped. Congress concluded that in order to reverse the relative decline in research spending by industry, an incentive in the form of a substantial tax credit was necessary to stimulate research. In this way, because the results of research may not affect earnings until many years after the research is performed, industry would be encouraged to commit additional resources to R&D.

Since the law has been in effect R&D expenditures have increased. Although I am not aware of any studies that trace the increase in spending directly to the R&D tax credit, it seems reasonable to assume that the credit has had some impact. Because the credit is restricted to research and product development which is truly innovative and is available only to the extent that the taxpayer increases its annual expenditures, it is an incentive which is precisely targeted to reward those activities which Congress sought to encourage. The effectiveness, however, is seriously eroded when an automatic expiration date exists and business cannot plan its long-term research program with the assurance that the credit will be available.

1. Suggested statutory and administrative changes

There are a number of changes which would improve the current law. Most of them are discussed above.

Briefly,

(I) We support the proposal that the R&E Tax Credit should be made a permanent part of the tax law (Section 1, above).

(II) We feel that depreciation associated with all facilities used for qualifying research should be allowed as a part of the credit (Section 4).

(III) We believe that software R&D should be treated in the same manner as any other research effort (Section 4).

(IV) We feel that "qualified research" should include certain post-production development costs (Section 4).

(V) Finally, we would support any change in the law which would encourage industry to continue and, in fact, to increase support of basic research at our universities. Since this issue did not appear in the Subcommittee items, the members may feel that it is obvious. The issue is so important, however, that it should be addressed explicitly in any new legislation.

Thank you, again, for the opportunity to make this statement.

Chairman RANGEL. We will hear from James Taylor.

STATEMENT OF JAMES A. TAYLOR, DIRECTOR OF TAXES AND CUSTOMS, VARIAN ASSOCIATES, INC., AND CHAIRMAN, TAX COMMITTEE, SCIENTIFIC APPARATUS MAKERS ASSOCIATION

Mr. TAYLOR. Thank you, Mr. Chairman and members of the committee. My name is Jim Taylor, director of taxes for Varian Associates in Palo Alto, CA. I am appearing today on behalf of the Scientific Apparatus Makers Association. We believe our industry demonstrates that the R&D tax credit is achieving its primary purpose of increasing R&D spending. The R&D spending in the instruments and measuring devices industry increased by 55 percent between 1980 and 1983.

According to a survey conducted by Business Week magazine and based upon information reported to the Securities and Exchange Commission, research spending by the largest companies in our industry rose from $578 million to $894 million between 1980 and 1983. That is a gain of almost 55 percent.

Sales were up from $13.1 billion to $16.7 billion during the same time period, or an increase of 27 percent. Thus even with a large increase in sales, research spending as a percentage of sales nevertheless rose by 23 percent during the same period.

We believe that the actual increases for our industry are even higher than the Business Week statistics, since they do not take into account small and medium size companies whose research spending is growing faster than the industry average. Also these figures relate to the period when the R&D credit was first being phased in, and do not reflect the conditions which would exist when the credit is fully implemented.

At Varian, company-funded research spending increased by 48 percent from 1980 to 1983. We expect an additional increase of approximately 40 percent in 1984. Thus we will have increased our own research spending by almost 90 percent during the 4-year period since the credit was enacted.

We believe the availability of the research and development credit coupled with the current deduction for these expenses provides the necessary incentive to conduct research within the United States. Thus our domestic research spending has dramatically increased while our foreign research spending has remained constant. This has occurred even though foreign countries where we manufacture provide significant financial and tax incentives to perform research within those countries.

I, too, have attached a summary of some of the foreign research incentives to my written testimony.

We also believe the research and development credit is one of the reasons for the rapid growth in research spending within our industry. A survey conducted by a University of Pennsylvania economist confirms that research spending in the instruments and measurement devices industry would have been almost 6 percent less had the research credit not been in effect.

At the same time, we believe the credit can be improved to make it more effective in achieving its objectives, preventing unintended uses and reducing its cost, which is an important consideration as Congress considers ways to lower the Federal budget deficit. This can be done by tightening the definition of qualifying research along the lines proposed in H.R. 4475, approved by the Senate in modified form this year.

In general, the definition of qualifying research should be tightened to focus on activities directed toward new products and processes, and functional improvements such as performance and reliability. It would eliminate style, cosmetic, taste, and seasonal design improvements often undertaken primarily for marketing reasons.

Also the definition's reliance on experimentation and testing will further limit its use to innovative research activities. This requirement provides that the development of an item must be by means of a process in which alternatives are formulated and tested, and then refined or discarded. This will ensure that the credit is not used for routine alterations, activities involving no risk, nor the mere application of another's product.

Most importantly, the research and development tax credit should be made permanent. Many of the truly innovatived R&D products consume 5 to 7, perhaps 10 years. Companies need to know when they plan for such projects whether the R&D credit will be available in order to more accurately assess the after tax cost of these projects.

In summary, we believe the R&D credit is a tool which greatly facilitates economic growth, the creation of jobs and our nation's ability to compete in world markets. This key to maintaining our technological leadership should not be allowed to expire in 1985.

Thank you.

Chairman RANGEL. Thank you. Both of your attached sheets, as well as that of Mr. Young, will be entered into the record.

[The prepared statement and supplemental material follow:]

STATEMENT OF JAMES A. TAYLOR, DIRECTOR OF TAXES AND CUSTOMS, VARIAN ASSOCIATES, INC., AND CHAIRMAN, TAX COMMITTEE, SCIENTIFIC APPARATUS MAKERS ASSOCIATION (SAMA)

SUMMARY

1. Research spending in the instrument and measuring devices industry has increased by 55% since the R&D tax credit was enacted in 1981. According to a survey conducted by Business Week magazine, research spending rose from $578 Million in 1980 to $894 Million in 1983. Sales rose from $13.1 Billion to $16.7 Billion, or 27% during this time. Even with these increases research spending as a percent of sales rose by almost 23% between 1980 and 1983. The R&D tax credit is one of the reasons for this growth in research spending.

2. Management is keenly aware of the value of the R&D tax credit and it is a major factor in approving overall research spending and the decision to invest in research instead of other sales enhancement costs. Making the credit permanent would enhance its usefulness by allowing better strategic planning and encouraging investments in longer term, innovative research projects.

3. The considerations—jobs, economic growth and ability to compete in world markets—which prompted Congress to approve the R&D tax credit in 1981 still exists. In addition, most foreign competitors (e.g., Canada, France, Great Britain, Japan, Sweden and West Germany) provide significant tax and financial incentives for research performed within their countries.

4. The R&D credit should not become a sacrificial lamb in the deficit reduction debate. Allowing the R&D credit to expire not only will eliminate a major incentive for our industry's increased commitment to research, it will mean that high technology industries such as ours—which already pay among the highest effective tax rates in U.S. industry—will suffer a substantial tax increase as a result of the 1981 and 1982 tax acts. Allowing the credit to lapse also will exacerbate the present disparity in taxation between high technology companies and capital intensive industries.

5. The definition of "qualifying research" should be tightened to make the R&D tax credit more effective in achieving its objective, preventing abuses and reducing the cost to the Treasury. The definition of "qualifying research" should be narrowed along the lines proposed in H.R. 4475 and passed by the Senate in modified form to focus on activities directed towards new products and functional improvements such as performance and reliability. Further, by requiring that the new product or process be developed by experimentation and testing, the revised definition would eliminate use of the R&D credit for routine alterations, activities involving no significant risk and mere duplication of another's product.

STATEMENT

Good morning Chairman Rangel and distinguished members of the Oversight Subcommittee. My name is James A. Taylor. I am the Director of Taxes and Customs for Varian Associates, Inc. Varian and its subsidiaries design, manufacture, and market a large variety of high technology electronic systems and components. These products include microwave, power, and special purpose electron tubes, solid state components and equipment for defense and communications; analytical instruments for science and industry; wafer fabrication equipment or the semi-conductor industry; radiation equipment for cancer therapy; vacuum equipment and leak detectors for industrial and scientific purposes; and miniature magnetic components for computers and telecommunications. Varian's worldwide sales were $760 Million in 1983 and are expected to reach $950 Million in 1984. Foreign sales account for approximately 20% of total sales. Varian employs almost 15,000 workers worldwide of which about 75% are employed in the United States.

I am appearing before you today in my capacity as Chairman of the Tax Committee of the Scientific Apparatus Makers Association (SAMA). Founded in 1918, SAMA is the national representative of the high technology scientific, medical and industrial instrument, laboratory apparatus and electronic controls industry. Its 200 member companies, many of small or moderate size, manufacture and distribute more than 40,000 types of high technology instruments and related products. This equipment is used in research, measurement, analysis, testing and control by Government, industry, education, public utilities, and health care professions. SAMA's members have combined annual sales in excess of $12 Billion. 40 percent of these sales are shipped internationally. Member companies have facilities in virtually every state, and employ more than 250,000 workers.

I am particularly pleased to have the opportunity to present our industry's views at these important hearings on how the R&D tax credit has been used. Our industry's experience indicates the credit has been extremely successful. Research activities in the instrument and measuring devices industry have increased since the R&D tax credit was enacted in mid-1981. Although some may argue that it is too early to draw any definitive conclusion, the available data for the instruments and measuring devices industry shows a clear trend. Actual research spending increased by about 55% over 1980 levels. R&D expenditures as a percentage of sales have increased by 25% since 1980. These research spending increases occurred even though 1981–1982 was one of the most severe economic recessions in the last 40 years. In addition, this was the first time since World War II that R&D spending actually increased in a recessionary period.

I also want to explain why the R&D credit should be continued and, in fact, made permanent. In addition, I will discuss how the R&D credit can be better targeted to focus on innovative research and experimentation projects directed to new and functionally improved products. In addition to making the credit more effective in achieving its objectives and preventing abuses, these changes will reduce the cost of the credit in terms of lost Treasury revenues, an important consideration as Congress considers ways to lower the Federal budget deficit.

BACKGROUND

Before discussing our industry's experience with the R&D credit, I would like to briefly review Congress' reasons for enacting the R&D tax credit in 1981. Congress recognized that domestic research is a critical component in providing economic growth, productivity, and an ability to compete in world markets. Congress also recognized that our domestic research spending was declining at an alarming rate. During the mid-1970's domestic research spending as a percent of gross national product declined by 10 percent, reaching a low of 2.23% in 1977-1978. At the same time, with the aid of Government incentives, both Japan and West Germany were increasing their R&D spending as a percent of GNP by at least 20%. This trend is being reversed due in part to the R&D tax credit. In 1983, U.S. research spending as a percentage of GNP is estimated to be 2.65%—about equal to that of Japan and West Germany.

Congress, realizing the implications of these trends on American world technological leadership and how a decline of that leadership would impact American jobs and our economy, devised the R&D tax credit. Its intent was to encourage U.S. companies to allocate more of their scarce resources to domestic research projects and thereby develop new and better products and processes to create jobs and meet foreign competition. Congress opted for a relatively high rate, incremental base credit which it concluded would provide the most efficient incentive. With an incremental base reflecting average R&D spending for the past three years, companies with stable R&D budgets would receive little, if any, tax reduction. At the same time, the incremental nature of the credit and the "rolling" base period require a continuous increase in domestic research spending to obtain on-going benefits from the credit.

Although domestic research spending increased since the R&D credit was enacted, the considerations which led Congress to pass the credit-job creation, long term economic growth, and ability to compete in world markets—still exist. Indeed, these considerations are of even greater importance today. At the same time, research projects have become more sophisticated, more costly and more risky.

OUR INDUSTRY'S EXPERIENCE

Our industry's experience demonstrates that the R&D tax credit is achieving its objective. Research spending in the instruments and measuring devices industry increased by almost 55% between 1980 and 1983. According to a survey conducted by *Business Week* magazine and based on information reported to the Securities and Exchange Commission, research spending by the largest companies in our industry rose from $578 Million in 1980 to $894 Million in 1983, a gain of almost 55%. Sales were up from $13.1 Billion to $16.7 Billion, or 27% during this period. However, despite this increase in sales, research spending as a percent of sales increased by almost 23% between 1980 and 1983. We believe that the actual increases for our industry are even higher. The *Business Week* statistics do not take into account small and medium size companies whose research spending is growing faster than the industry average. It should also be remembered that these figures relate to the period when the credit was being phased-in.

We believe the R&D tax credit is one of the important reasons for the recent growth in research spending. A survey conducted by University of Pennsylvania economists indicates research spending in the instruments and measuring devices industry would have been 3.7 and 5.9% lower in 1982 and 1983 without the R&D credit.

Varian's experience

At Varian, research spending increased from $34 Million to $50 Million from 1980 through 1983. This is an increase of about 48%. We expect an additional increase of about 40% for 1984. Thus, we will increase our research spending by almost 90% in 4 years. During the 1980-1983 period sales increased by approximately 37% from $554 Million to $760 Million. Sales are expected to grow another 25% in 1984. These figures show conclusively that our research spending is increasing faster than sales.

Our foreign research spending has remained constant. Thus, our domestic research spending accounts for all the increase. This occurred even though foreign countries where we manufacture provide significant financial and tax incentives to perform research within their countries. (A summary of those incentives is attached to this statement). In fact, our operating and research people periodically cite these incentive as reasons why we should perform more research abroad. However, the availability of the R&D tax credit, coupled with a current deduction for these expenses, provides a sufficient incentive to perform research within the U.S. Thus, we are able to justify performing most of our research within the U.S.

At Varian, the R&D tax credit definitely was an incentive in helping us increase our research investments. Our management is keenly aware of the value of the credit, and it is a major factor in determining the overall amount of money that will be used for research in a given year versus other sales enhancement costs. There is absolutely no question that it has helped us to increase our R&D and to engage in projects that would not have been undertaken if the credit was not available.

EXISTING BENEFITS FROM THE R&D CREDIT

In assessing the value of the R&D credit as an incentive to increase research spending, a number of conclusions are readily apparent. First, the incremental nature of the credit requires those companies which wish to realize tax savings to continuously increase qualified domestic research spending. Second, most companies have a limited amount of resources available to achieve their financial goals at differing levels of activity. Many diverse business needs (e.g., R&D, plant expansion and modernization, marketing costs, etc.) must be met with these limited resources. The existence of the R&D credit provides additional leverage to the corporate R&D managers in the competition for scarce corporate funds since top management is aware of the special tax incentive associated with increased research spending. Third, since the credit is only available for research performed in the United States, this encourages companies to conduct their research in this country counterbalancing the importance of foreign incentives.

THE R&D CREDIT'S EFFECT ON LONG-TERM PLANNING

One disadvantage of the credit is its expiration at the end of 1985. This, along with the natural bias in favor of short-term results, probably has encouraged companies to focus on short-term R&D projects at the expense of longer term, more innovative research programs. Making the R&D credit permanent would go far towards eliminating this problem. It also would allow better corporate strategic panning and result in more productive utilization of corporate funds. It would also send a clear signal to U.S. businesses that our nation is truly interested in sustaining our technological leadership. This is of critical importance especially when other nations are trying to attract our industries' research activities.

THE R&D CREDIT'S RELATIONSHIP TO THE BUDGET DEFICIT

It is important that Congress not allow the R&D credit to become a sacrificial lamb in the deficit debate. Allowing the credit to sunset in 1985 not only will eliminate a valuable incentive for vitally important R&D activities, but also will mean that high technology companies—which are already taxed at some of highest effective tax rates in U.S. industry—will have suffered, on net, a substantial tax *increase* as the result of the combined effect of the 1981 (Economic Recovery Tax Act) and the 1982 (Tax Equity and Fiscal Responsibility Tax Act) Acts. Allowing the credit to lapse also will exacerbate the present disparity in taxation between high technology companies and capital intensive industries.

Equally important, if the R&D credit is not available, U.S. business may not have as much capital to devote to the research process as it would if the credit is extended. This deficiency could impede the development of new processes and products which in turn could adversely impact sales both in the U.S. and overseas. The long term consequences would be fewer U.S. jobs, lower U.S. income thereby reducing tax revenues, and a worsening of the balance of payments position at least for our industry since such a large portion of our products (more than 40%) are exported. In addition, failure to extend the R&D tax credit would send a clear signal to our industry that the Federal Government does not consider technological leadership to be a top priority.

IMPROVING THE CREDIT

We believe the credit can be improved to make it more effective in achieving its objectives, preventing abuse and reducing its cost, which is an important consideration as Congress considers ways to lower the deficit. This can be done by tightening the definition of "qualifying research" along the lines proposed in H.R. 4475 and passed by the Senate in a modified form this year.

Tightening the definition of qualified research—experimentation as the cornerstone

In general, the definition of qualifying research should be tightened to focus on activities directed towards new products and functional improvements such as performance and reliability as compared to cosmetic or stylistic changes. This definitional change requires that the new products or process be developed by experimentation and testing of alternatives.

This change in the definition of qualified research would narrow the category of activities eligible for the R&D credit. First, eligible R&D activities would be limited to predominately functional improvements. This eliminates the entire category of style, cosmetic, taste, and seasonal design improvements often undertaken purely for marketing purposes. It also eliminates all improvements in which cosmetic changes dominate functional changes. In addition, by requiring that the product or process be developed by experimentation (including the development and testing of alternatives, as well as the elimination of some and the refinement of others), the revised definition of qualified research excludes those product development activities in which the specific alternative required to reach the desired objective is readily discernible from the start and readily attainable without the significant risk that is necessarily reflected in the process of testing and experimentation. Also, the exclusions with respect to post-research activities such as planning for commercial production and adaptation of an existing product to specific customer needs will provide a clearer and more enforceable line that will foreclose a taxpayer from claiming the credit with respect to activities which no longer constitute experimentation to develop new products but instead are part of the initial stages of commercial production.

ROUTINE ALTERATIONS SIGNIFICANT RISKS AND MERE DUPLICATION

At the same time, the definition's reliance on experimentation and testing will, in our opinion, further narrow use of the credit to innovative research activities. This requirement, which provides that the development of a business item must be undertaken by means of a process in which alternatives actually are formulated and developed and tested and then refined or discarded, addresses the general concern expressed that the R&D credit should not be available for "routine" alterations to existing products or processes, for product development activities that involve no significant risk as to attainment of the desired objective, and for the mere replication of another's product or process.

The concept of experimentation also provides an administrable framework for separating truly "routine" or "mundane" activities from those activities involving a significant risk that specific alternatives will not give rise to a usable result. If a taxpayer can show through working papers or similar documentation setting forth the history of the project that alternatives were in fact developed and tested, and that some were discarded and others refined and adopted, the experimentation requirement will have been met. In such situations the very fact that experimentation was undertaken means that the activities were not "mundane" or "routine" and involved some risk that specific alternatives would not give rise to a usable and desirable result.

If, on the other hand, the alternative required to reach the desired objective is readily discernible and readily attainable from the beginning, so that true testing need not be undertaken to develop or evaluate alternatives, the product or process would not be new or significantly improved and would fail to qualify for the credit. Excluded under this provision, for example, would be the activity of developing a product or process to duplicate another company's product or process from specifications, blueprints, or plans that are publicly available or are obtained by license or similar arrangement. By contrast, a product or process would qualify as new or significantly improved for credit purposes where, in order to create the item, the taxpayer initially examines a competitor's product or process and then must formulate a substantially new design through a process of experimentation that requires the testing of alternatives and reformulation based upon the knowledge gained from such tests.

Making the credit permanent

Most importantly, the R&D credit should be made permanent. Until that occurs, the credit will not achieve its full purpose and encourage corporate investments in long term, truly innovative R&D projects. Many of these innovative R&D projects consume 5–7, maybe 10 years, with the greatest costs coming towards the end of the project. Companies need to know when they plan these projects, and hire research scientists and engineers and set-up research facilities, that the credit will be available for the duration of the project.

Extending the credit for a shorter period, say three years, may encourage companies to focus on short term R&D projects where results are greatest and most likely to occur. However, it is the risky, more speculative projects that often achieve the technological breakthroughts. Congress can and should encourage these truly innovative projects by making the credit permanent.

UNIVERSITY BASIC RESEARCH AND CONTRIBUTIONS OF STATE-OF-THE-ART EQUIPMENT

We also support fine-tuning of existing provisions to provide increased incentives for university research and donations of state-of-the-art equipment.

In many colleges and universities, education in mathematics, engineering and the physical, biological and computer sciences continues to suffer from a chronic shortage of faculty and a severe lack of up-to-date scientific equipment upon which both students and faculty can learn and perform research. Universities not only face great difficulty in stretching tight budgets to compete with private firms for graduate-level engineers but also are unable to attract high caliber faculties because of their antiquated laboratory facilities. At the same time, basic research has traditionally been conducted in college and university laboratories. However, industry funding of this basic research has declined from 11 percent in the 1950's to 3 percent today. Thus, we support the creation of a special credit for corporate funded university research.

Similarly, expansion of the present enhanced deduction to corporate contributors of scientific equipment and apparatus to colleges and universities as proposed in H.R. 4475 will complement the university research provisions and help colleges and universities to increase their research capabilities and upgrade and expand their science curriculum.

Mr. Chairman and members of the Oversight Subcommittee, on behalf of SAMA, thank you for allowing us an opportunity to present our views on how the R&D tax credit has been used by the instrument and measuring devices industry, and how we believe the credit should be modified to make it more effective. Your interest in this important issue is appreciated, and we look forward to working with you and others of the Ways and Means Committee to extending this important tool for maintaining our technological leadership.

BRIEF SUMMARY OF R&D INCENTIVES IN SELECTED COUNTRIES

Germany

German Government provides grants or loans for R&D purposes, often on a 50-50 basis.

In Berlin, cash grants for up to 40% of investments in R&D are available for first DM 500,000 and 30% for amounts exceeding that level.

Italy

Government provides aid for costs of R&D projects up to prototype stage if projects have particular technological importance and carry high industrial risk. Aid includes:

a. Loans of up to 80% of cost of project at 4.3% interest rate.

b. Grants of up to 40% of reaserch costs which must be repaid only if R&D is successful.

Sweden

Government grants available for up to 50% of R&D costs. Grants are reimbursable if project becomes commercially viable.

United Kingdom

Government will provide grants of up to 25% of R&D costs or participate in a 50-50 shared cost contract. In special development areas subsidies of 15% or 22% of buildings and equipment which support "scientific work" are available.

Ireland

R&D projects can qualify for government grants of up to 50% of cost of the project (or £250,000, whichever is smaller). Manufacturing companies may qualify for grants of up to 50% of consulting costs.

France

Grants (in the form of government contracts with a specific objective of the research) are available for up to 50% of R&D project costs, reimbursable if project is immediately marketable.

Belgium

R&D equipment eligible for special depreciation over 3 years.

Interest-free loans are available for up to 80% of cost of development of prototype; repayment is required only if invention becomes profitable.

Canada

ITC of 10% to 50% available on R&D expenditures. Rate of credit dependent upon location of project.

Thru 1988, additional 50% deduction (over 100% current year write-off) for R&D expenditures that exceed average of prior 3 year base-period.

Cash grants, loans, and loan guarantees are made available for R&D projects by a number of government agencies.

Japan

Tax credit available for incremental R&D expenditures. Credit is 20% of increment, up to a maximum of 10% of corporate tax liability.

Korea

Tax credit available for 10% of expenditures for technology and manpower development, including compensation for research personnel, investment in R&D materials, expenses for test production of new products, training of personnel and information costs.

Australia

Government grants available for up to 50% of expenditures for R&D.

Mexico

Tax credits for 15% - 20% of investment in R&D machinery and equipment.

Firms receiving income from licensed technology developed in Mexico may take tax credit of 10% of such income.

VARIAN ASSOCIATES, INC.
Palo Alto, CA., September 14, 1984.

Mr. WILLIAM KIRK,
Staff Director, Subcommittee on Oversight,
Committee on Ways and Means, Washington, DC.

DEAR MR. KIRK: As requested by the Subcommittee members at the August 3, 1984 hearings on the R&D Tax Credit, attached are Varian's responses to the additional questions which were posed. Also attached to my response is the more detailed description of major foreign research and development incentives as specifically requested during the hearings.

As indicated in my August 27th letter, it is difficult to pinpoint exactly which projects were undertaken solely on account of the R&D credit primarily due to its incremental nature. I have nevertheless attempted to provide at least some concrete examples of how the credit was used at Varian.

As previously indicated, our industry is committed to seeing this valuable tax incentive extended. Therefore, we are very willing to continue discussing ways to improve the effectiveness of the credit as well as responding to any further questions which you may have. Consequently, please feel free to contact us at any time if we can be of any further assistance.

Very truly yours,

JAMES A. TAYLOR, *Director of Taxes.*

SUPPLEMENT STATEMENT OF JAMES A. TAYLOR, DIRECTOR OF TAXES AND CUSTOMS, VARIAN ASSOCIATES, INC.

During the August 2 and 3 hearings on the Research and Development Tax Credit, subcommittee members asked each business witness to provide answers to certain additional questions for the record. Therefore, the purpose of this statement is to respond to those additional inquiries on behalf of Varian Associates, Inc. and its subsidiaries (hereinafter "Varian").

1. *How Much Did Your Company Spend on R&D During 1981, 1982 and 1983?*

Varian spent the following amounts on Company-funded research and development during the three years in question:

Year ended	*Amount in millions*
Sept. 30, 1981	$38.6
Sept. 30, 1982	41.3
Sept. 30, 1983	50.2

Although the year has not yet been completed, we expect Company-funded R&D costs to be approximately $65 million for fiscal 1984.

Varian also expended the following amounts on R&D which were funded by customers.

Year ended	*Amount in millions*
Sept. 30, 1981	$13.7
Sept. 30, 1982	16.3
Sept. 30, 1983	15.2

2. *What was your Company's R&D Spending as a Percentage of Sales?*

Varian's Company-funded R&D spending as a percentage of sales was as follows:

Year ended	*R&D as a percentage of sales*
Sept. 30, 1981	6.0
Sept. 30, 1982	6.0
Sept. 30, 1983	6.6

Company sponsored R&D spending is expected to be almost 7.0 percent for fiscal 1984 with a forecasted sales increase of approximately 25 percent.

3. *How Much R&D Credit Did Your Company Claim?*

Varian claimed the following amounts of R&D credit.

Amount of credit

Year ended	*Thousands*
Sept. 30, 1981	$69
Sept. 30, 1982	819
Sept. 30, 1983	3,542

Although the year is not yet completed, our financial forecast indicates we should be allowed to claim well in excess of the $3.5 million as R&D tax credits for fiscal 1984.

4. *Effect of R&D Credit on Varian's Federal Tax Liabilities.*

Although not specifically requested, we believe it is important to point out Varian pays significant amounts of corporate income tax as do many other companies within the high tech electronics industry. This is not the case for many other sectors of American industry. In addition, Varian's U.S. employment has increased from about 10,000 people to 11,000 since 1981. These individuals contribute personal income and employment taxes to the Treasury, in addition to the corporate income and other federal taxes paid by Varian itself.

Varian's net federal tax liabilities were approximately $1 million, $8 million and $16 million for fiscal 1981, 1982 and 1983. Our net federal tax liability as a percentage of federal taxable income was approximately 13%, 20%, and 30% for the same three years. Had the R&D tax credit not been available, comparable percentages would have been approximately 14%, 22%, and 37%. Thus, once fully implemented, the R&D tax credit has had a significant impact upon our Company's effective federal tax rate (i.e., 37% vs. 30% or a 7% reduction for fiscal 1983)! By reducing our effective tax rate, Varian has more money available to invest in its business of developing and manufacturing new products.

5. *What Types of R&D Projects Have Been Undertaken Because of the Credit?*

Varian is a world leader in the manufacture of:

a. Microwave, power and special purpose electron tubes and devices for defense and communications;

b. Analytical instruments for science and industry;

c. Wafer fabrication equipment for the semiconductor industry;

d. Radiation equipment for cancer therapy or inspection of industrial equipment and parts;

e. Vacuum equipment and leak detectors for industrial and sceintific purposes; and,

f. Minature magnetic components for computer and telecommunication equipment.

All of our product lines require continuous investment in both basic and applied research. Research funds are spent on developing brand new products and to significantly improve existing products. As previously stated, Company-sponsored research spending has increased significantly in each of the years since 1980 and such increases are expected to continue. The R&D tax credit is one of the primary reasons for this incresase. Thus we can say the R&D tax credit has had a very positive impact on our research spending for *all product* lines.

Within our industry there are usually more good research opportunities to work on than available funds. The selection of which R&D projects will be funded is made through a cost-benefit analysis. The R&D tax credit increases the overall amount of funds available for R&D spending. It, therefore, increases the number of projects which can be funded or allows us to accelerate research on existing projects.

Due to the incremental nature of the R&D tax credit, it is difficult to determine exactily which projects were undertaken because of the credit. However, two projects Varian undertook because the credit made them financially feasible were (1) our research on use of nuclear magnetic resonance machines to perform diagnostic medical testing, and (2) research into the commercial application of a hypothermia technique to cure cancer by heating and destroying cancerous cells without damaging surrounding tissue.

Another approach to determining the impact of the R&D tax credit would be to look at the work in those divisions whose R&D spending increased most dramtically since the credit was enacted. Following this criterion, the R&D tax credit stimulated Varian's research spending in the following product lines:

a. Microwave integrated circuits for the semiconductor industry;

b. Developing various solid state electronic devices such as oscillators and amplifiers;

c. Developing new features for liquid and gas chromatographs;

d. Developing new types of sputtering machines, electron beam lithography systems and their molecular beam epitaxy machines for use by the semiconductor wafer fabrication industy;

e. Developing new products such as the use of gallium arsenide in the manufacture of integrated circuits and in the development of solar cells to power communications, etc.

6. *What are Some of the Tax and Financial Incentives Provided by Foreign Countries to Conduct R&D?*

As agreed during the August 3 hearings, attached is a more compehensive statement of tax and financial incentives to perform research & development provided by certain of our more prominent foreign trading partners. As seen, Canada, France, Japan and Korea all provide special tax credits for research performed within their countries. These credits are similar to the R&D tax credit provided under IRC Sec. 44F. These countries allow deductions for research expenses as in the case within the U.S. Most also provide direct grants or other financial incentives which is not generally the case here. However, on balance, the benefits provided by these countries are at least comparable to the current package of tax benefits provided by the U.S.

Most of the other countries for which information is supplied provide grants, low interest rate loans and other financial and tax benefits to companies conducting research within their borders. Each package of benefits is different; however, they all produce sizeable incentives.

Many other countries (e.g., Australia, Ireland, Israel, Taiwan, etc.) provide significant incentives to perform research within their borders. Specific information about the incentives offered by these countries has not been provided due to time constraints. However, we would be willing to supply such additional information at a later date should members of the Committee deem it important.

We wish to thank the Committee for allowing us to submit this supplementla information on how the R&D tax credit affected our Company and why we believe it should be made a permanenet part of the corporate tax system of the United States.

RESEARCH AND DEVELOPMENT INCENTIVES IN SELECTED COUNTRIES

Canada

(1) *Deductions.*—Current and capital expenditure (except land) relating to R&D are fully deductible in the year in which incurred.

(2) *Credits.*—A tax credit is available equal to 20% of all current and capital expenditure (except land) relating to R&D. This credit reduces the amount deductible under (1). There is a carryback of 3 years and a carryforward of 7 years. The credit is based on total R&D expenditure, not on some increment.

Investors buying financial instruments which are issued for the purpose of financing R&D are entitled to a credit against their own tax liability equal to 50% of the financing provided. The financing does not have to relate to a specific R&D project, nor does the investor have to acquire any right to the result of the R&D effort.

To ensure that the issuer of the financial instrument actually performs the R&D effort, he becomes liable for income tax for an amount equal to the credit acquired by his investors, against which liability he can offset 50% of the qualifying R&D expenditure incurred.

(3) *Grants.*—The "Industrial Research Assistance Program" allows for sharing up to half the salary costs of specified large R&D projects.

The "Enterprise Development Program" provides cash grants, loans or loan guarantees to firms carrying out a variety of R&D activities such as industrial design projects, product development and design of microelectronic utilization projects. Contributions of 50% of eligible project costs are available to manufacturing concerns where the cost of the project represents a significant financial burden. Control Data, NCR of Canada, and Westinghouse Canada are among the recipients of grants under this program.

(4) *Miscellaneous.*—For the purpose of applying the above incentives, R&D is carefully defined by Income Tax Regulation 2900. It includes basic research, applied research and development, but excludes market research, routine testing, research in social sciences, commercial development and styling.

Germany

(1) *Grants.*—The "Investment Premium Law" provides for grants based on the investments in depreciable fixed assets used for R&D activities for a period of at least three years. They amount to 20% of the first DM 500,000 ($170,000 at present rates) invested, and 7.5% of the excess. For buildings it is required that more than ⅔ of the total space is used for R&D in order to obtain a grant based on the total cost. If the space utilized for R&D is between ⅓ and ⅔, the grant will be based on 50% of the cost. Movable tangible assets and intangibles need to be utilized entirely for R&D in order to qualify for a credit. These grants do not constitute taxable income nor do they reduce the depreciable basis of the assets concerned.

Under the research program of the Federal Ministry of Research and Technology, grants can be made available for research and development projects, normally amounting to 50% of total cost. In 1982 the Federal Government provided DM 3.2 billion ($1 billion at present rates) worth of subsidies for projects carried out by domestic and foreign firms. Foreign-owned companies receiving grants include Standard Electric Lorenz (a subsidiary of ITT), Philips (Dutch) and Brown-Boveri (Swiss). German recipients include Siemens, AEG-Telefunken and Hoechst.

Japan

(1) *Deductions.*—Current R&D expenditure may be deducted immediately, and shorter useful lives for tax accelerated depreciation are available for capital R&D items as follows: equipment 4 years (normally 6 years), building equipment 5 years (normally 11 years) and machinery 7 years (normally 11 years).

(2) *Credits.*—An R&D tax credit equal to 20% of incremental R&D expenditure may be claimed. The credit may not exceed 10% of the tax liability against which it is claimed. The increment must be established on the basis of the highest annual R&D expenditure incurred since 1967.

(3) *Grants.*—A Technical Research and Development grant may be awarded if the research is within designated fields such as environment, energy, electronics, optoelectronics. The amount of the grant may be as much as 50% of the total costs including acquisition of fixed assets.

(4) *Miscellaneous.*—Special exclusions from income for certain overseas transactions resulting in royalties and technical service fees from foreign sources are avail-

able. This exclusion amounts to 28% of the consideration received in a foreign currency for the transfer or use of industrial technology, know-how, etc., developed by the corporation and to 16% of the consideration received for the rendering of technical services for overseas construction projects, under certain conditions. To obtain this special exclusion, certification as to the eligibility of the transactions concerned must be obtained from the Ministry of International Trade and Indusries (MITI). The maximum exclusion is limited to 40% of the taxable income for the accounting period.

France

(1) *Deductions.*—A 50% special depreciation allowance is granted in the year of investment of the cost of acquisition or construction of buildings used solely for technical research. The residual book value is then depreciated over the remaining useful life of the building.

Businesses which purchase shares in Qualified Research Companies may deduct 50% of the cost of the shares in the year of acquisition. This deduction is allowed against ordinary income and results in reduction of the tax basis in the shares. On a subsequent sale of the shares, the "additional gain" attributable to this special 50% deduction would be eligible for capital gains treatment. Moreover, if the shares are held for at least three years, no capital gains tax is payable on the gain relating to the 50% deduction.

Current as well as capital R&D expenditure (other than buildings) may be deducted in the year during which they are incurred.

(2) *Credits.*—An R&D tax credit equal to 25% of incremental R&D expenditure is available, limited to FFRS 3 million per taxpayer per year. The increment is to be computed on the basis of R&D expenditure of the previous two years, adjusted for inflation. The expenses to be taken into account include amortization of fixed R&D assets, salaries of R&D personnel and overhead relating to R&D.

(3) *Grants.*—Grants for R&D activities are available in the form of a contract between the Ministry of Industry and the investor. Each contract contains the precise objective of the research project and the amount of the subsidy granted, which never exceeds 50% of the project cost. The company receives the funds in yearly installments. If the research project is immediately marketable, the company must pay back up to 120% of the subsidy. If the project fails, the company does not have to reimburse the state.

(4) *Miscellaneous.*—Royalty income resulting from the license of patents and know-how which is self-developed or acquired more than two years ago is taxable at 15% instead of at the normal income tax rate of 50%.

United Kingdom

(1) *Deductions.*—Current and capital expenditure for R&D is deductible in the year in which incurred. Capital expenditure includes machinery and equipment, buildings and lease premiums.

(2) *Grants.*—Companies can receive substantial project-specific assistance for R&D in those sectors for which programs are in operation. The Department of Trade and Industry is currently operating 10 major aid schemes in high-technology fields. These are as follows: the Microprocessor Applications Project; the Microelectronics Industry Support Program; the Fiber Optics and Opto-electronics Industry Scheme; the Software Products Scheme; the Flexible Manufacturing Scheme; the Robot Support Program; the Computer-aided Design and Computer-aided Manufacturing Program; the Computer-aided Design and Test Equipment Program; the Small Engineering Firms Investment Schemes I and II; and the Biotechnology Support Program.

Most of these programs provide funding both for background R&D and for progress into the pilot production stage, as well as offer less-specialized companies assistance with incorporating the advanced technologies into their existing production processes. In addition, the Product and Process Development Scheme helps manufacturers overcome the high development costs of new products (not just in high-technology sectors).

In most of the R&D-related incentive schemes, the Department of Trade and Industry will provide a grant of up to 33% of eligible costs or participate in a 50:50 shared-cost contract, in which the government share would be repaid by a levy on sales or advances on preproduction orders. Some programs are subject to upper and lower limits on eligible costs.

The state-owned British Technology Group offers financing for R&D on a 50:50 cost-sharing basis. It sometimes makes allocation of any patentable discoveries a condition of its support, and imposes a levy on future sales; but it has been known to accept repayment of its outstanding share of the costs, leaving the company in full control of the patent.

Korea

(1) *Deductions.*—A reserve for R&D expenses can be set up, and the amounts allocated to this reserve can be deducted from taxable income. The ceiling is the higher of 30% of taxable income or 1.5% of total revenue (20% and 1%, respectively, for companies not in technology-intensive industries). Insofar this reserve is not utilized to fund R&D activities during a period of four years following the allocation, it has to be added back to taxable income.

Current R&D expenditure is deductible in the year in which incurred. For equipment and facilities used for R&D activities, accelerated depreciation of 90% may be claimed in the first year, the remaining 10% being depreciable at normal rates.

(2) *Credits.*—A credit equal to 10% of the acquisition costs of R&D assets may be claimed against income tax.

A tax credit equal to 10% of expenditures for technology and manpower development—including compensation for research personnel assigned to new product development, investment in materials for R&D, expenses for test production of new products, outlays for internal and outside training of personnel, and information costs—is available. The combined amount of credits claimed for R&D expenditures, and R&D asset purchases may not exceed 30% of total tax payable. A carryforward of 4 years is available for the credit.

(3) *Miscellaneous.*—Local source royalty income derived from the licensing of registered patents, models or designs is exempt from income tax for a period of five years. 50% of foreign source royalty income, including payments for secret know-how and manufacturing methods, may be excluded from taxable income. The combined amount of deductions and exclusions claimed for the R&D reserve, the accelerated depreciation of R&D assets and foreign royalties may not exceed 50% of taxable income.

Italy

(1) *Grants.*—Law No. 46, effective Jan. 1, 1983, stipulates that firms may apply for state aid toward the cost of applied research up to the prototype stage if they are planning projects that have particular technological importance and carry a high industrial risk. Various types of aid are available:

(a) Soft loans of up to 80% of the aggregate cost of the R&D project, at a fixed interest rate of 4.3%, compared to a prime rate of presently 17%.

(b) Grants of up to 40% of the research cost; and

(c) A contribution to R&D expenditure. Under this system, Istituto Mobiliare Italiano (IMI) issues a grant that must be repaid if the research is successful. If it fails, IMI does not ask for the money to be repaid but acquires the results of the research.

Financial aid cannot exceed 80% of the total cost of the project. However, a maximum of 90% can be granted for projects considered high priority for reaching the goals listed in the industrial plans drafted for a number of strategically important sectors by C.I.P.I., the interministerial committee for industrial planning. So far, the largest share of available funds—over 50%—has gone to electronics companies.

Subsidiaries of multinationals carrying out R&D in Italy can get aid, provided they carry out the research in Italy, utilize the results of the research in Italy and do not transfer abroad the know-how acquired without an adequate charge.

Law No. 46 also established a fund to aid companies that introduce technological innovations. Endowed with L1.5 trillion ($800 million at present rate), the fund provides aid toward the cost of technological research programs up to the point of commercial exploitation. The law specifies that the research program must be part of a medium-term corporate strategy and must be compatible with the size and structure of the applying company.

Aid is available in the form of soft loans worth up to 80% of the cost of the project and repayable over a maximum of 15 years, with the first capital repayments of principal starting only after five years. Interest is calculated as a proportion of Italy's reference rate, at present 20.6%. The proportion is 15% during the first five years (which means a current interest rate of 3.09%) and 60% during the last 10 years (a current rate of 12.36%). It is also possible to transform up to half of the loan into a grant.

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Chairman RANGEL. Our last witness is Dr. Saloom for the American Electronics Association.

STATEMENT OF JOSEPH A. SALOOM, SENIOR VICE PRESIDENT, CORPORATE COMPONENTS TECHNOLOGY DIVISION, M/A-COM, INC., REPRESENTING THE AMERICAN ELECTRONICS ASSOCIATION

Mr. SALOOM. Good morning. My name is Joe Saloom and I am a senior vice president, M/A-COM Corporate Components Technology Center in Massachusetts. I have a prepared statement of the American Electronics Association which I would like to make part of the record at this time.

Chairman RANGEL. Without objection.

Mr. SALOOM. I am probably at the end of the line on the hierarchy of where R&D is conceived and carried out. I am a research director of a small group of people. We do advanced work in microwave devices, components, and subsystems that are used in commercial, industrial and Government end use. When I joined the company 10 years ago, our sales were about $50 million, and this year they will be over $750 million. We now have operations in 11 States. I am not a tax authority.

I want at this time to thank this committee for holding these hearings. My thesis today is the R&D tax credit has had a real and positive effect on increasing and broadening the research effort in M/A-COM. It has worked in my opinion the way it was intended. We would have increased our R&D anyway, I am sure, during this period. It is part of our life, but we wouldn't have taken high risks that we did take during this 3-year period. We chose to increase our R&D significantly last year when our profits were down at least 25 percent, and R&D went up about that amount. As a R&D director that has never happened to me before in my life. Usually advertising is cut and then research is next. It didn't happen this year. R&D tax credit made a real difference in my life and in the life of the scientists with whom I work.

Let me share one example with you. The subject is gallium arsenide. I know that is a complex word. It is a semiconductor. A more familiar semiconductor is the one Ian mentioned, silicon. Silicon is the base material for a multibillion-dollar industry in this country. Research has shown that in certain cases gallium arsenide can outperform silicon. It is an emerging technology. Silicon is more mature as a technology. Gallium arsenide is the technology I believe will be used by the Japanese in the fifth generation computer. It is the latest technology we have added to our satellite communications.

Today the Japanese are ahead of us in almost every area in gallium arsenide. They are the largest supplier of the wafer materials and the devices made from the material.

Well, we reviewed this market just a few years ago, and decided that the risks were very high. The timing, the rate of return, were very uncertain, but in my mind, it was a good long-term investment not only for our company but for our Nation. The technology signs were very positive that it would be important to make a commitment in this area. We had a lot of internal debates. We chose to build what we believe today is the largest, best equipped and manned facility in the United States for gallium arsenide. I invite you to come visit our plant in Lowell, MA, which we are just moving into now.

We decided to build a $25 million modern semiconductor building, but when we built the building, it meant our R&D had to increase significantly from a few hundred thousand dollars a year to almost $5 million as a going R&D expense per year, and it will grow from that point. That R&D tax credit—I was there—had a big effect on that decision. We would still have moved into gallium arsenide, but not at the rate and not with the amount of investments that we did make. It gave us courage to make such an investment.

Today we are planning investments in R&D projects that will not occur until 1986-87. With the uncertainty of the extension, we have a very nervous stomach about such investments. This decision must be made, and made rapidly. This tax credit has a significant effect on increasing our R&D.

Let me just make one further comment. I heard my friend Ian say how long range R&D is. A lot of it is, but some isn't. In the case of gallium arsenide, less than 3 years ago we were zero in making materials. The Japanese were No. 1 and the Canadians were No. 2. In the United States today we are now No. 1. Three months ago we had 62 employees in this particular effort. Yesterday we had 76. Next year we will have 38 more people added to that group. A static analysis on the return of the R&D tax credit should include those cases where the return is within the 3- to 4-year period.

It reminds me almost of the GI bill of rights. I wouldn't be here today if it weren't for the GI bill of rights. I would like someone now to make a calculation of its payback. It is 40 years ago that I graduated. I was able to attend a university that I could not have attended without the GI bill. I think the R&D tax credit is like that. You get some short-term benefit. I got a job at Bell Labs with my new Ph.D., but it took years to really see the payoff.

Thank you very much for listening to our appeal today.

[The prepared statement follows:]

STATEMENT OF JOSEPH A. SALOOM, SENIOR VICE PRESIDENT, M/A-COM, INC., ON BEHALF OF THE AMERICAN ELECTRONICS ASSOCIATION

SUMMARY

From my experience at M/A-COM, I can tell you that the R&D tax credit is being used; it is stimulating increased R&D activities; and it is needed to maintain technological leadership in the U.S.

Expiration of the credit would significantly increase the already heavy effective tax burden of the high technology sector. It would also symbolize the loss of a Federal commitment to technological leadership.

Loss of the credit would undermine the ability of U.S. high technology companies to compete internationally. If our companies lose their leadership in world markets they will quickly lose their ability to compete at home.

Disappearance in 1984 of the U.S. trade surplus in electronics products is a clear indication that this nation's technological leadership is threatened.

U.S colleges and universities are suffering from a lack of technical degree faculty and from insufficient research and research training facilities. These factors also threaten the technological resource base on which future innovation must be predicated.

Congress should make the R&D credit permanent; provide incentives to encourage greater private participation in university basic research; expand deductions provided for corporate donations of scientific equipment to colleges and universities; and provide forgiveness of taxes on faculty development loans.

STATEMENT

"Congress could take the initiative in devising programs that would actively support the electronics industry, and others of comparable importance. The first requisite is broad national agreement on the role of high-technology sectors like electronics as a driving force for future economic growth . . . The second is better understanding of how particular pieces of legislation affect the competitiveness of American industry . . ." Office of Technology Assessment.[1]

Mr. Chairman and distinguished members of the Subcommittee, I am Joseph A. Saloom, Senior Vice President, Corporate Components Technology Division, of M/A-COM, and Director of our Components Technology Center. I am pleased to have the opportunity to discuss the research and development tax credit, both from a national perspective and from my own experience at M/A-COM.

M/A-COM was founded in 1950 as Microwave Associates, Inc. and adopted its present name in 1978 to reflect the company's diversification. We have evolved from a company that chiefly sold microwave products to the military into a designer and manufacturer of equipment and systems for use in satellite communications, data communications, television broadcasting and cable television (CATV). M/A-COM is the nation's largest supplier of coaxial cable for the CATV industry and a major designer and manufacturer of numerous digital communications products as well as microwave semiconductors, components and subsystems and other products for commercial and defense applications.

I am appearing before you today on behalf of the American Electronics Association. AEA now represents over 2,600 companies nationwide, encompassing all segments of the electronics industry, including manufacturers and suppliers of computers and peripherals, semiconductors and other components, telecommunications equipment, defense systems and products, scientific instruments, software, research and office systems. AEA's membership includes companies of all sizes, from "startups" to the largest companies in the industry. But 72 percent of AEA's members employ fewer than 250 people. Together, AEA member companies account for $140 billion in sales—63 percent of worldwide sales of the U.S.-based electronics industry.

Mr. Chairman, the Subcommittee has scheduled these hearings to determine the use and effect of the R&D tax credit, enacted in 1981. I am here to tell you that it is being used; it is effectively stimulating increased R&D activities; it is needed as a feature of our government's policy to maintain technological leadership and U.S. competitiveness; and it should be extended permanently.

Innovation: Key to international competitiveness

The Congressional Research Service states that "innovation is a major mechanism to increase U.S. productivity, to expand the number of jobs available, and to improve the country's balance of payments. Economic growth is stimulated through the utilization of new processes and the manufacture of new products. Innovation also contributes to the resolution of national problems which are amenable to technological solutions." [2]

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[1] "International Competitiveness in Electronics," Congress of the United States, Office of Technology Assessment, November, 1983, p. 7.

[2] "Major Legislative Issues," Issue 6, Congress of the United States, Congressional Research Service, June, 1984.

In 1983, worldwide sales of U.S.-based electronics companies were $265 billion. Domestic employment of these companies is 2.3 million Americans. Since 18 percent of the electronics product produced in the U.S. is exported, nearly one electronics job in five depends directly on exports.

Because of the breakneck pace with which new products are developed and introduced into the marketplace, entire product lines often become obsolete within a period as short as three years. Thus, in the extremely competitive electronics industry, companies must spend a significantly higher proportion of their sales dollar on R&D than in other industries. They also tend to reinvest their profits, rather than paying them out in the form of higher dividends. This means that they plow their profits back into funding further innovation.

These two factors—high R&D costs and short product lives—mean that high tech companies must be competitive internationally. If they are not competitive in foreign markets, they'll lose their ability to compete at home.

In short, survival in high technology industries depends on innovation. And innovation depends on research, both basic research and applied research.

The need for basic research for technological innovation

Through the use of basic research at our nation's universities, technology has been created and transferred throughout the economy. The existence of Silicon Valley firms in California and Route 128 companies in Massachusetts attest to innovation genesis from universities.

While U.S. government dollars for basic research between 1967 and 1977 remained fairly constant, Japan increases its spending by 60 percent, West Germany by 50 percent, and France by 16 percent. Most of these foreign dollars are targeted in areas with economic and commercial significance. In the United States, an unhealthy 50 percent decline of industry basic research dollars going to universities has taken place since 1960—from 8 percent to 4 percent.

The decline in R&D industry dollars to educational institutions has also contributed significantly to the present shortage of some 2,000 engineering faculty. Unlike a decade or so earlier, our country's best and brightest students are now opting for industry employment, not only because of higher salaries but because academia no longer offers attractive and interesting research opportunities.

The international threat

The U.S. export balance of trade for electronics and information technology products virtually disappeared in 1983. Department of Commerce data reveal that U.S. electronics exports totaled $26.8 billion and imports $26.7 billion, resulting in an export trade balance of only $100 million in 1983. The export trade balance for 1980 was $6.3 billion based on exports of $21.8 billion and imports of $15.5 billion. Further, trade in this area is expected to suffer a deficit for the first time this year.

A comparison of the trade and investment strategies of the United States and its trading partners reveals some significant contrasts. The Office of Technology Assessment states that "foreign governments are experimenting with industrial policies intended to aid and support their own electronics industries; virtually all industrialized and industrializing nations single out electronics for special treatment." [3]

A recent study by Dr. Steven Johnson of the University of Pennsylvania concludes that the Japanese government, for example, has provided a "more liberalized deduction of R&D expenditures and provided significant tax credits to offset the cost of increasing R&D expenditures for Japanese firms." [4] These tax incentives, available since the mid-1960s in Japan, effectively lowered the cost of R&D to Japanese firms, providing a diversion of resources to R&D. Johnson also notes that the disparity between Japanese and U.S. tax incentives for R&D has been reduced since the enactment of the R&D tax credit under ERTA.

A staff report of the Office of Technology Assessment analyzes R&D expenditures of our trading partners as a percent of GNP as a general indication of the priority nations place on R&D. Again looking at Japan, the study notes that its total expenditures climbed from 15 percent of those of the United States in 1970 to 40 percent of the U.S. figure in 1980. Civilian R&D expenditures in the United States in 1980 were 1.69 percent of GNP. In Japan, they were 2.30 percent; and in West Germany, 2.53 percent.

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[3] "International Competitiveness in Electronics," op cit., p. 7.

[4] Steven Johnson, "Comparing R&D Strategies of Japanese and U.S. Firms," Sloan Management Review, Spring, 1984, p. 25.

Current tax laws place disproportionate burden on high technology

A study conducted earlier this year by a group of 20 high technology electronics companies concluded that the tax reductions of the Economic Recovery Tax Act of 1981 have "not been equally shared among taxpayers." [5] Indeed, the report points out that "Federal income tax burdens on high technology electronics companies in 1982 were from 40 to 75 percent higher than for the average U.S. corporation."

Brookings Institution economist Robert Z. Lawrence echoes this argument in his book, "Can America Compete?" by stating that "for new investment, the range of effective tax rates has increased from 27.4 percent to 48.4 percent." [6]

In short, while federal policies can significantly influence corporate R&D strategies, most of the business tax incentives of ERTA largely missed the mark for high technology companies. Even with the R&D tax credit, high technology companies are treated unequally under our tax laws Ironically, it is these firms which offer some of the brightest prospects for productivity and employment growth in the future.

The need for Federal commitment to R&D

The recent Office of Technology Assessment report, "International Competitiveness in Electronics," finds that "the United States can continue to be highly competitive in electronics and other technology driven industries, with U.S. firms remaining leaders in innovation, in international trade, and in sales and profits at home and abroad. Not only is this possible, it is necessary if the United States is to maintain its standard of living, its military security, and if the U.S. economy is to provide well-paying and satisfying jobs for the Nation's labor force." [7]

The R&D credit stimulates the process of innovation

The study by Dr. Johnson of the University of Pennsylvania states that "Government/institutional parameters tend to exert a significant influence on the formulation of corporate R&D investment strategies in both [Japan and the United States], since capital budgeting and other corporate decisions are highly sensitive to such parameters." [8] (Steven Johnson, "Comparing R&D Strategies of Japanese and U.S. Firms," Sloan Management Review, Spring, 1984, p. 25.)

Congress recognized both the importance of high technology industries to the U.S. economy and the need to support these industries when it enacted the R&D tax credit under ERTA.

Through the R&D credit, the federal government is able to target the process of innovation as a means of stimulating more R&D in the U.S. In this manner, the government plays a role in our nation's ability to innovate and remain internationally competitive.

The credit was kept from being a special interest measure by applying to all industries in the economy. It does not involve government central planning, but directs federal support to activities in which companies believe enough to be investing their own funds.

Effect of the R&D credit on corporate decisionmaking

Existing data indicate that the R&D credit has had a positive effect on R&D expenditures in the United States. R&D expenditures actually increased during the last recession, unlike the previous one. In fact such expenditures have increased both in nominal terms and as a percent of sales, indicating real growth in the amount of resources devoted to R&D in the United States. A recent Business Week survey reveals that R&D as a percent of sales rose from 3.9 percent in 1980 to 5.4 percent in 1982 and 1983, the highest rate since 1976. As a percent of pretax profits, R&D spending rose from 48.7 percent in 1980 to 87.9 percent in 1983.

Despite this evidence, it is difficult empirically to establish a dollar-for-dollar relationship between money retained by companies through the credit and money diverted to R&D. However, the overwhelming body of evidence points to the fact that the tax credit effectively influences corporate decisions. Given a choice between funding an activity supported by a tax credit or another activity which does not carry such a credit, corporate decisionmakers naturally will be "tilted" toward the credit activity.

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[5] "High Technology Tax Policies of the 1980s," Ad Hoc Electronics Tax Group, January, 1980.

[6] Peter Behr, "Money—Cost Gap Between Japan, U.S. Still Huge," Washington Post, June 24, 1984, p. G9.

[7] "International Competitiveness in Electronics," op cit., p. 7.

[8] Johnson, op cit., p. 25.

In short, since the credit is reflected on the corporate "bottom line" and since electronics companies tend to plow their profits back into productive activities, the credit clearly increases the resources available to a company to increase its productive capacity.

More experience with the R&D credit is needed

It is ironic that the credit faces extinction. On the one hand, it easily can be established from evidence both here and abroad that a tax credit provides an economic stimulation to the activity to which it is applied. But on the other hand, critics state that there is insufficient data to demonstrate actual use of the credit is increasing R&D expenditures.

Reliable data regarding the use of the credit is difficult at best to obtain. After the credit was enacted, there was a natural "education gap" during which companies first learned about and then learned how to apply the credit to their operations. Moreover, since the benefit level of the credit was phased in over three years, experience information relating to the first year or two of the credit cannot be assumed accurately to reflect long term trends.

Adding to this irony is the fact that by the time the credit had become fully operational, it also had become apparent that it was due to expire in the near future. Since corporations plan and budget their R&D activities for several years in advance, the pending expiration of the credit meant that corporate decision-makers could not rely on its existence in planning medium and long term R&D programs. In effect, the expiration date has diluted the credit's incentive effect.

Will the credit be allowed to expire because of insufficient data, even when reliable data is unavailable?

The potential expiration of the credit poses another problem. Should it be allowed to expire, it will signify the loss of Federal commitment to continued leadership in technological innovation. It also will result in an increase of taxes for an industry which already is burdened with higher effective tax rates than other U.S. industries. The loss of the credit clearly would undermine the ability of high technology industries to compete domestically and internationally.

IMPROVEMENTS NEEDED IN THE EXISTING R&D CREDIT

So far, I have attempted to demonstrate that the tax incentives of ERTA are an efficient and effective way to stimulate research activities in the United States. This is not to say that those provisions cannot, and should not be improved.

Most importantly, as I have indicated above, the pending expiration of the credit already is detracting from the stimulative effect of the credit. Therefore, the credit should be made permanent.

Startups

A study by Dr. Joseph Cordes of George Washington University reveals that about 40 percent of the companies which are eligible for the credit actually are not able to apply it in the year of their R&D expenditures. For high technology industries, 60 percent of eligible firms are unable to claim the credit.

A major cause of this discrepancy is the fact that start-up corporations cannot claim the credit as now drafted, since they have no income against which to apply it. It is these very start-ups which represent the vanguard of innovation and future employment opportunities in our economy. Does Congress wish to discriminate againt these new and small companies in favor of more mature companies? A simple solution to this problem is to allow start-up corporations to carry forward to taxable years their pre-production research costs.

Software

The IRS has taken the position that the credit does not apply to software development costs, even when such software is a significant component of a new business item which resulted from qualifying R&D activities. The R&D credit should clearly establish that development costs of such software are eligible for the credit.

Abuses should be eliminated

Just as there are activities which do not qualify for the credit, but should; there are other activities which should not qualify for the credit, but do. Such activities usually relate to seasonal, cosmetic, or stylistic design modifications rather than to functional innovations. Therefore, the definition of qualifying R&D should be restricted to the development of truly innovative improvements to business items.

IMPROVEMENTS NEEDED IN RESEARCH AND RESEARCH TRAINING INCENTIVES

As I have noted, innovation depends on research. But without top notch researchers and lab facilities, both in our high tech companies and in our nation's post-secondary education institutions, our ability to conduct essential research will be curtailed. Thus, our efforts to encourage research must also take into account our educational research and training base in the United States.

High technology's need for technical human resources

AEA's report, "Technical Employment Projections: 1983-1987", indicates a need by 1987 for 63.1 percent more electronic technicians, 65.5 percent more electrical engineers, 115 percent more computer (software) engineers, 102.5 percent more computer analyst/programmers, and 107 percent additional electronic engineering technologists. And in spite of what one reads about mechanization, there continues to be a healthy projected need for 63.7 percent more assemblers.

The major cause of this shortfall in the human resource arena is that too few faculty and poorly equipped engineering and scientific teaching laboratories in this country's two and four year colleges and postsecondary vo-tech schools are blocking admittance of new students and lowering the quality of learning for those lucky enough to find classroom space.

AEA's Blue Ribbon Committee on Engineering Education estimated that two out of every three qualified applicants to undergraduate electrical/electronic and computer engineering programs cannot presently gain admittance.

Faculty vacancies approach 50 percent in some high tech specialty areas, such as solid state, digital systems, and computer engineering.

This country needs 1,000 new engineering faculty each year through 1990 just to remain in a steady state. Yet, we are producing only 450 professors annually. Furthermore, 50 percent of the technical degree doctorates awarded in 1982 went to foreign students, two-thirds of whom are likely to return to their homelands after graduation.

Need to refurbish lab equipment

To bring instructional labs up to the needs of today's students would require about $2 billion.[9] This sorry situation is a result of steadily declining educational budgets for capital expenditures.

For example, in the California State university system, funding for replacement of instructional equipment in enginneering has been less than 2 percent annually of its replacement costs, requiring a 59-year life cycle to complete the replacement process. In Texas, legislation was introduced to set up a $67 million fund for the purchase of engineering equipment to revitalize the State's engineering colleges and universities. Because technology is changing so rapidly within the industry, many university laboratories are becoming so obsolescent that the technological future of the country is at risk.

Labs in our nation's post-secondary education institutions commonly contain 20 to 30 year old equipment, and instrumentation to teach new "growth technologies" is almost non-existent. As the president of one Fortune 500 company remarked after a tour of a university engineering department, "The only time my engineers will see equipment of this type is when they tour the Smithsonian."

The problems of our four-year institutions also exist at our community colleges and postsecondary vo-tech schools: too few qualified instructors and outdated laboratory equipment but an abundance of interested students.

Effect of current tax incentives on research and training

Just as ERTA provided incentives for increasing corporate research and development activities, the Act also included important incentives for university research and research training. These incentives, too, have been extremely effective in improving our nation's capacity to innovate.

An annual Council for Financial Aid to Education (CFAE) survey shows a 56.5 percent increase in dollar value or a 4 percent increase of all corporate funded university departmental research grants between 1980 and 1982. In 1980, CFAE reports 19 percent or $64.7 million of all gifts went toward departmental research; in 1982—after the passage of ERTA—24 percent or $114.6 million went for such research. According to CFAE, the types of corporate gifts shifted between 1981 and 1982 toward increased donations of company products.

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[9] "Engineering Education Problems: The Laboratory Equipment Factor," National Society of Professional Engineers, Washington, D.C., September, 1982.

Although CFAE did not specifically ask in its survey questionnaire why the increases in research dollars and equipment occurred, it seems logical to infer that the degree and kind of contributions were influenced by availability of the federal tax incentive. The latest Conference Board survey substantiates the CFAE trend. Additionally, several AEA members attest to the fact that the tax provisions of ERTA have resulted in their substantially increasing their support for university research and research training programs.

Improvements to current law need to be made

While ERTA has had a significant effect on corporate support for university research and education programs, too few companies are able to take advantage of the incentives of ERTA and too few colleges and universities are able to benefit from those incentives. The shortfall of qualified researchers and research facilities needs to be addressed as soon as possible. Therefore, the research and lab equipment provisions of ERTA need to be liberalized.

First, to encourage greater participation and collaboration by private firms with universities on basic research projects, the tax credit for a corporation's payments to universities for basic research should be expanded. The credit should be made available to payments in excess of a fixed, maintenance-of-effort floor.

Second, deductions provided under ERTA for corporate donations of scientific equipment to post-secondary education institutions should be made available for a wider range of recipients and uses. Eligible uses should include direct scientific education as well as research and research training. Contributions should include software as well as state-of-the-art equipment up to three years old.

Third, corporate donations should be made available to community colleges and post-secondary vo-tech schools for use in math, engineering, and physical and biological sciences. These institutions not only "feed" into four-year colleges and universities, requiring parallel kinds of quality instructional capability, but they are commonly the first and last training grounds for the majority of entry-level employment, retraining and upgrading for most of our country's workers.

Fourth, taxes on faculty development loans should be forgiven. Private industry is currently spearheading a donation program to fund, and promote graduate education for those who are interested in teaching careers. AEA, for example, has had an active national program to assist engineering education and thereby help increase the availability of qualified scientific, engineering, and technical personnel since 1981.

Forword looking students, however, view future tax indebtedness as a negative feature when offered financial aid to pursue a doctoral degree to become a professor. Efforts by individuals and companies to build a pool of scientific and engineering faculty could be enhanced with an exclusion of these loans and grants from tax liability.

EXPERIENCE WITH THE R&D TAX CREDIT AT M/A-COM

Having established the need for and effect of the R&D tax credit in terms of our national and international competitiveness, I now would like to concentrate on how M/A-COM specifically has used the credit. I have been assisted in preparing this portion of my testimony by John R. Colbert, Treasurer of M/A-COM, Inc., and Mr. Stephen Zezima, Esq., our Corporate Tax Manager.

Fiscal 1983 was a record year for M/A-COM, with sales reaching $637 million. However, because of the worldwide recession, profits were down and earnings per share fell 30 percent from the previous year. In spite of reduced profits, we substantially increased research and development expenditures in 1983. I want to discuss this in more detail in a moment.

M/A-COM: A leader in technological innovation

M/A-COM is a leader in the high technology industry in the United States. In the digital communications area, our products include sophisticated modems used to increase the capacity, reliability and security of satellite communication systems; a line of digital processors used for multiplexing data streams into packets for efficient transmission; satellite communications terminals for real time data transmission for business communications; and microwave data transceivers for local distribution of data. We have developed satellite communications systems for the Department of Defense, and we are the largest supplier of digital Time Division Multiple Access (TDMA) satellite terminals for commercial satellite communications networks.

In the microwave components area, M/A-COM manufactures a broad line of products that generate, control and receive microwave energy. These products incorporate microwave semiconductor technology and are sold to manufacturers and users of military radar, missile guidance systems, electronic countermeasures equipment, and navigation systems. Some of the specific products include PIN diodes, used to control the passage of electrical energy through circuits; Schottky-barrier and point contact diodes, used to receive and detect microwave signals; Gunn diodes, used to generate low levels of microwave power; and microwave transistors, used to amplify microwave signals. M/A-COM now has in place the technology base to manufacture the underlying materials—silicon, gallium arsenide and ferrites—used for microwave components, as well as the ability to manufacture circuits, assemblies and subsystems for commercial and defense products.

Research and development at M/A-COM

We at M/A-COM were greatly heartened by the recognition of the importance of industrial research and development displayed by members of this committee in enacting the R&D tax credit as part of the Economic Recovery Tax Act of 1981, and we have sought to do our part in continuing the American tradition of industrial growth. As a "high technology" manufacturing company, we are acutely sensitive to the continuing need to grow; research and development provides the fertile soil which companies like ours must have in order to prosper.

We view our own research and development programs as the vital element which enables us to maintain the place of leadership we have earned in our own industry.

Our research has application in many facets of American life. For example, microwave sensor technology which was developed for the space program has been applied by our scientists to medicine, resulting in a device which is able to detect both existing and incipient cancer tumors in the human body by sensing a heat differential unique to a tumor. Another device, also in the same testing stage and using similar microwave technology, will allow the treatment of tumors with a heating process, eliminating in many cases the need for surgery.

Effect of R&D credit at M/A-COM

Mr. Chairman, we appreciate that the question before the committee is: "Does the R&D tax credit work? Does it encourage companies to undertake research and development efforts which it would not otherwise undertake?" The answer from M/A-COM is a resounding "Yes!!"

The credit has been in effect for only two years; yet in that time it has become embedded in the thinking of our company's senior management, and has had the effect of heightening the corporate priority for research. Of course, M/A-COM will perform research and development activities regardless of the presence or absence of the credit, but that is not the question. What has happened is that a "tilt" has been created in favor of expanding our effort at a more rapid rate, just as you intended when you enacted the credit. It is too soon yet, and in fact may never be possible to quantify the exact correlation between the dollars we recovered through the credit and the additional dollars we spent on R&D. I can, however, offer some examples of specific M/A-COM R&D efforts which were effected by the credit.

Since the credit was enacted, M/A-COM has made the decision to intensify its research in gallium arsenide (GaAs), a material which could be used with or in place of silicon in semiconductor components. Within the last year, we have made the commitment to acquire a $20 million facility to house this research and the manufacturing that results, and we will, of course, equip and populate it to the tune of many millions more. The presence of the credit made it much easier for us to commit to this level of effort, even though it represents an outlay far in excess of any we could expect to recover from the credit for years to come.

This program illustrates the effect of the credit on our corporate thinking; it also represents the difficulty of making a direct correlation between the credit and a given effort. Our GaAs effort is a long-term program. Decisions we make today will influence our company for decades to come. With that in mind, it is obvious that no such decision is made solely on the basis of a credit we can't count on being there permanently. On the other hand, this investment represents a major risk of assets for us. The willingness of the government to recognize that risk through the credit is no small factor in our willingness to undertake it.

There is one other thing I should mention about GaAs. It represents one of the technological areas in which the United States does not enjoy clear technology superiority over our trading partners, including Japan. Perhaps the safe play for us would be to stay in an area where we already have the head start. By contesting vigorously for leadership in an area of international technological competition in which the outcome is not assured, we multiply our risk. We believe that this is precisely what you wanted us to do when you enacted the credit, and we are doing it.

There are other fields in which the United States does not possess clear technology superiority and in which we are also pursuing research, such as digital satellite telecommunications. From M/A-COM's perspective, this is very important to our corporate growth. Because we are competing vigorously in the international market and selling this equipment in other countries, we are improving U.S. trade balances. Digital satellite equipment requires sophisticated R&D, and we are committing our funds more readily than we might have done in the absence of the tax credit.

I have spoken at some length of the impact on our corporate thinking that the credit has provided. Let me give you a few figures to illustrate what it has meant to us financially. In fiscal year 1983, based on total sales of $637 million, we had about $33 million of tax-qualified R&D. In 1982 we had about $28 million in tax-qualified R&D, and in 1981 we had about $18 million. This gave us a tax credit for 1983 of about $3.5 million. It should be noted that there is a substantial difference between tax-qualified R&D and the R&D calculated according to financial accounting principles.

The $3.5 million tax credit is not a massive sum of money for a company with sales of $637 million. From a profitability standpoint, however, we consider it to be significant—nearly 11 percent of our profits of $31 million, or about 8 cents per share of common stock. Moreover, it is a sign to our management team that the policymakers in Washington do care about stimulating technological development. To us, it is significant that the tax credit has created an atmosphere that is favorable to R&D; in the long run, this is more important than the specific dollar effects.

Need to extend the R&D credit

Mr. Chairman, my point up to now has been to demonstrate that the R&D tax credit has been doing exactly what Congress wanted it to do; it is stimulating manufacturing companies like M/A-COM to increase our research and development efforts. Our message to you is simple: in order to retain and enhance this atmosphere that encourages corporate R&D, we suggest that you make the credit a permanent part of the Tax Code.

Research and development activities are long-term projects and can best prosper in an environment of long-term stability. Our gallium arsenide research, which I discussed above, is a long-term effort. Virtually all of our R&D programs are of the same nature; long-term commitments of corporate resources to ventures with uncertain futures. The R&D tax credit is due to expire this coming year, which makes long-term planning difficult.

If the R&D tax credit is allowed to expire, the positive influence that has developed will evaporate, and we are afraid that a negative environment will develop. Top corporate executives will perceive that the Federal Government made a conscious decision to take away a useful incentive in spite of its demonstrated value. The result could be a decreasing rate of R&D expenditures that would be contrary to the best interest of U.S industrial policy and national security.

In sum, Mr. Chairman, we believe that the public policy benefits of the R&D tax credit far outweigh the revenue costs. We also believe that the R&D tax credit is an invitation from the Federal government to companies like ours to reinvest our revenues in America's industrial future through research and development. We have accepted that invitation and ask only that you continue it by making the tax credit permanent.

Chairman RANGEL. A very distinguished panel, and we thank you for your testimony. I assume that all of you gentlemen agree that if the credit is extended it should be targeted. Let me put it another way, based on your facial expressions. Do you believe that the credit should be used for new recipes for fast-food outfits?

Mr. SCHICK. I don't think that anybody here does. I think it would be a mistake, Mr. Chairman.

Chairman RANGEL. What is that?

Mr. SCHICK. I think it would be a mistake to target by industry.

Chairman RANGEL. How about facial designs?

Mr. SCHICK. We agree that that would not be appropriate.

Chairman RANGEL. Hair stylists and models?

Mr. SCHICK. If you could fix my hair, I would call it high technology.

Chairman RANGEL. We are going to need some help from the Chamber of Commerce especially. Your job is to make certain that you get maximum profit, and we don't have any problem with that.

Mr. SCHICK. I believe that this could be handled by restricting it to the true sciences, and that would be better than going by industry.

Chairman RANGEL. I am not saying that we have an answer. I don't know the direction that the Congress or the committee is prepared to go. I am prepared to say that especially with the Chamber of Commerce, that since you have experience with a broad spectrum of industries, that you could help us by coming up with specific recommendations rather than say hook the credit into place forever. This will help us in the long run, and also would help us to persuade those who are opposed to the credit concept—that is, the flat-tax people—that it makes a lot of sense. We need some help from you. I am asking staff, based on the data that you put in the record and their own research, to see how much contribution other countries are making, directly or indirectly, to corporations through subsidy or through the tax system. This way we can get some idea as to where you are losing the competitive edge.

Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman.

Will some of you give us the information that Mr. Rangel has asked for, about the other countries?

Mr. TAYLOR. Yes; we have attached a brief summary to our testimony, but a couple of the companies here have agreed, because of the interest, to work with people overseas, to try to get a true up-to-date picture in the major industrialized countries, and to submit it for the record.

Mr. DUNCAN. Would any of you other members of the panel care to comment on how we could deal with the perceived abuses of the R&E credit?

Mr. YOUNG. Mr. Duncan, I would be happy to respond to that. Our company, and I think CBEMA and associated industries, have spent a lot of time on this question of the definition of R&E, since we are well aware that there have been abuses—perceived abuses anyway—and also we have problems of our own. You have heard the discussion about software, and the difficulty in defining what qualified software really is.

It is our understanding that the language that is in the Senate bill is agreed to by the Treasury and by many of us as representing about as good a description of the kind of technical R&D that really comes within the meaning, direction and the spirit of the R&E tax credit provision.

Mr. DUNCAN. Would any of you care to comment about the possibility of research being moved offshore, unless the R&D credit is substantially extended or made permanent?

Mr. KROWE. Congressman Duncan, I will venture a view on that. I believe that today, with the presence of the 861 extension, and with the presence of the R&E tax credit, I believe that balance is tilted in favor of doing R&D in the United States, all things being equal. I am concerned that should the R&E tax credit be let to expire at the end of 1985, that piece of the incentive will be lost, and I think it is a very delicate matter then as to whether or not the balance favors R&D in the United States. Clearly, as I mentioned earlier, in our instance we have grown R&E quite rapidly in the last 3 years, and it has been more rapidly in the United States than it has been outside of the United States.

Mr. DUNCAN. Are all of you in substantial agreement with that statement?

Mr. TAYLOR. Yes; I am. I would also like to point out that during the time period when the credit has been in effect, people from some of the manufacturing operations that we have overseas, although they are smaller, will come and say, "Should we not be doing more R&D in the country where we are going to be producing the products?"

Essentially we have analyzed the benefits available in those particular countries, and determined that the package of R&D financial incentives here in the United States, including the R&D credit make it much more beneficial financially to do so here at this time. Without the credit, it would not be as financially feasible in some instances.

Mr. DUNCAN. Thank you.

Mr. ROSS. Mr. Duncan, could I add something to this very important point. I am well aware of the pressures, the suction to bring R&D over into other countries. I think it is very important that we do deal with this issue, but I see it as a double-whammy situation, in that the foreign nations don't just want R&D over there because it means more employment. What they are asking us to do is to teach them how to do their own R&D, and what we are really facing is the possibility that we could lose one of our most precious competitive aspects.

Mr. DUNCAN. Thank you, gentlemen. Thank you, Mr. Chairman.

Chairman RANGEL. Mr. Pickle.

Mr. PICKLE. Thank you, Mr. Chairman.

I think you gentlemen have given us powerful testimony, consisting of, in part, the factual information we should have. I regret you only had 5 minutes. I wish you could have taken longer, but we will read and study your statements.

I want to ask each one of the panelists if you would submit to us, if your statement hasn't included it, how much R&D you have performed since this R&D credit has been in existence. How much has it grown, and how does it relate to productivity? I would like to know how much money you have committed to R&D, and I would like to know what types of R&D you carry on. If your statement doesn't include this information, you may submit it. We need to look at facts and figures.

I don't have many questions except I think I would ask Mr. Krowe this: Yesterday we had the GAO, CBO and Treasury appear before us, and they indicated that there was no clear evidence, no positive evidence that the R&D tax credit was responsible for increased R&D or productivity, but they couldn't prove that it was not. I don't think they said that, but they kind of indicated that.

I would ask you, Mr. Krowe, or any of you gentlemen, how can the industry show that there is a direct correlation? Can you do that?

Mr. KROWE. Congressman Pickle, I believe we can. I believe that we can show that, because it is substantiated in fact, and can be demonstrated in the figures that represent our results of operations. I believe there are national statistics that when analyzed and evaluated will show a unique level of expenditure and growth in R&D during this recent 1981-82 recession that is unprecedented, and I believe that this growing weight of fact can indeed be demonstrated.

I would add, sir, that some of the difficulty with the surveys that people have been doing on the effect of the R&D tax credit in my mind might well be caused by the people who are being surveyed. Now, what I mean by that is particularly in the 1981-82 time frame, if one surveys R&D managers, laboratory managers, even in our company, I would not at all be surprised to have the laboratory manager or the R&D manager not see or not be aware of any relationship between the R&D tax credit and the amount of R&D that his particular project may be assigned. There is a very straightforward, very natural reason for that.

The decisions on allocations of resources are made at much more aggregate levels in the company, and there has been a significant direct result of the R&D credit on our expenditures. I think some of these surveys have asked the wrong people.

Mr. PICKLE. Mr. Taylor, I believe it was, pointed out that research spending in his industry had increased by 55 percent.

Mr. TAYLOR. 55 percent, that is right.

Mr. PICKLE. I think Mr. Krowe said that for $1 invested you get approximately $5 back. That is powerfully strong testimony. To the extent that you could give us facts and figures to show this correlation I think it would be helpful to the committee, because we are trying to relate the credit we give to the good that it does in our economy. That is important with this committee, and your information will be helpful.

Mr. Krowe, you also discussed the tendency to compare R&D spending with lost tax revenue.

Mr. KROWE. Yes.

Mr. PICKLE. We have heard testimony that additional R&D does not match the tax loss. Would you care to comment on that allegation?

Mr. KROWE. Of course, the information on that is highly fragmentary, and very early in the cycle. I believe that the R&D tax credit is in the true essence an investment in the future, and I can tell you that it is our experience that for every 25 cents of a R&D tax credit that we garner, we intend to return that fivefold to the Treasury in additional taxes paid, and I believe that there is every reason to expect that that level of performance and return from our research and development will continue, so I see this from our perspective as a sound investment by the Government.

Mr. YOUNG. Mr. Pickle, could I add something to extend those remarks?

Mr. PICKLE. Yes, sir.

Mr. YOUNG. I was just figuring on the back of an envelope, so to speak, as this conversation was going on, and while Mr. Krowe was responding regarding the increased corporate taxes eventually produced from R&D activities. I hope you will not lose sight of the fact that the high technology industries are high growth industries. For example, we employ 80,000 people around the world in our company, and we have hired 10,000 in the last year.

The calculation I was just making—we are looking at the incremental R&D we spent, as I reported to you, because of the tax law—and the incremental growth we got related to the number of people we hired, who are of course all tax-paying citizens. And as I look at that increased payroll stream, and the resulting taxes, and the fact that for every new manufacturing job you get about three other jobs formed in the economy, my quick calculation shows that we return in terms of payroll tax an amount about exactly equal to the R&D tax credit we got during the year, without any measure of our corporate taxes.

So I think the power of this R&D credit in terms of the growth, the dynamics in the economy, is an extremely leveraged one, and it is all too easy to take quite a narrow tax expenditure viewpoint and not really see the dynamic impact throughout the competitive system.

Mr. PICKLE. From my standpoint, living in a city that is so directly affected by the high tech industry, I think it almost speaks for itself, that the more you participate in R&D, the more return you are going to get. I don't see how there is any alternative in this modern day if we are going to be competitive at all internationally, but this committee and the Congress will need the best facts and information you can give us to carry this out.

I don't think you are in a position to say we ought not give the credit to the hairgrowers or to the cookers. That is something we have to ask ourselves, but it is a question we are asking. We must try and define these credits in the most appropriate manner, if we are going to continue the program.

One last question. Do any of you have any feeling as we approach this subject whether we should sunset the credit, whether we should extend it, or whether we should make it permanent?

Chairman RANGEL. Make it permanent.

Mr. PICKLE. Mr. Rangel has suggested that you would want it made permanent. Do you have any other opinion?

Mr. SCHICK. Mr. Pickle, in our view there has been too much of the turning on and off of the spigot, and particularly in an area which in fact is long term, it is just not right to do it that way. Now, that is not to say that once this Nation has restored its commanding lead that one can't relook at that, but to have an automatic date that isn't tied to some event or achievement that is measurable is not right.

Chairman RANGEL. I think it is unfair to ask the Chamber of Commerce whether they would want a tax credit to be less than permanent.

Mr. PICKLE. What you are asking for is a period of some certainty so you know what you can depend on with respect to your own investment?

Mr. KROWE. Congressman Pickle, our testimony, my testimony in fact, does directly address that. We believe that an extension of at least 5 years would carry the kind of time horizon that would allow the long-term nature of R&D decisions to be made. We earnestly believe that within that 5-year time period, the learning experience will be such that it will be indeed a step toward permanence.

Mr. PICKLE. I thank all of you for your very good testimony.

Chairman RANGEL. We thank this distinguished panel for its contribution. I do hope that you will be able to submit the things that the members have requested and will have that recommendation for the full committee. Thank you very much.

[The following responses were subsequently received:]

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September 17, 1984

The Honorable Charles B. Rangel
Chairman, Subcommittee on Oversight
Committee on Ways and Means
U.S. House of Representatives
1102 Longworth House Office Building
Washington, D.C. 20515

Dear Chairman Rangel:

Dr. Ian M. Ross, President of AT&T Bell Laboratories, appeared before your Subcommittee on August 3, 1984 on behalf of the American Telephone and Telegraph Company and AT&T Bell Laboratories with respect to Section 221 of the Economic Recovery Tax Act of 1981, the Research and Experimentation Credit. Subsequently, you requested additional information to help the Committee evaluate more fully the effects of the research tax credit. This is the response of AT&T to that request.

1) AT&T has claimed the research tax credit for the amounts shown in the following taxable years:

1981	$ 39.0M
1982	89.6M
1983	114.0M

2) AT&T claimed the credit for a broad range of activities. The attachment describes these activities and provides examples of products and services for which the credit was claimed. Activities described in the attachment include those that are generally regarded as basic research, applied research and product development; however, we do not describe our work in these terms.

With respect to products to which these activities relate, the line between a new item and one which is so significantly improved from a predecessor that it is tantamount to a new product is hazy at best. For example, does the substitution of touch-tone pads for rotary dials or does the addition of new features, such as one button calling for the last number dialed, result in a significantly new telephone? The 4ESS™ switching system today contains little of the hardware contained in the original version introduced 8 years ago; the adoption of advanced technology has resulted in smaller size and lower power consumption while changes in hardware and software have resulted in higher call carrying capacity and added features. Similarly, the use of advanced electronics has resulted in more than an order of magnitude increase in the capacity of in-place microwave radio relay stations even though the antennas, waveguide, power supplies, etc., have not been changed significantly.

3) Final products or processes resulting from qualifying activities are illustrated in both sections of the attachment. In some instances, of course, results of today's research activities will be reflected in future products and services not known today.

4,5) The R&E tax credit is one of several sources of funds for research and development work in the AT&T companies. With the funds from the tax credit, more R&D will be undertaken than without them. Beyond that, we cannot identify the specific products or activities that are the direct result of the credit nor those that would not have been undertaken absent the credit. Cost-benefit analyses are not sufficiently precise to permit an after the fact determination of projects at the margin.

6) Nearly all of the expenses reported as "qualified" expenditures for the credit are included in research costs reported to the SEC. In 1983 AT&T reported $862.2M in research costs to the SEC and Western Electric reported $1,358.9M of research expenditures, for a total of $2.221 billion. Of the expenses reported as qualified expenditures for the R&E credit, ninety-seven percent were reported to the SEC as research expenses.

7) If the tax credit is made permanent our "long-term research budgeting and planning" activities would have a greater degree of predictability. As Dr. Ross testified, sustained and continuous funding is essential for research underlying many fundamental technological advances.

8) It is not possible to state the detailed effect on our research activities were the definition of qualifying expenditures narrowed to include basic and applied research, but not development expenditures. As noted

above in item 2, applied research and development activities are not separated by a clean, bright line so that questions of interpretation could arise. Furthermore, the development of prototypes is frequently necessary to demonstrate the feasibility of a project.

I hope that these comments are helpful to the Committee. If there is any additional information we can supply, we will be pleased to do so.

Sincerely,

WL Kaufman

Att.

SUPPLEMENTARY INFORMATION REQUESTED BY

SUBCOMMITTEE ON OVERSIGHT
COMMITEE ON WAYS AND MEANS

U.S. HOUSE OF REPRESENTATIVES

ON THE SUBJECT OF

RESEARCH AND EXPERIMENTATION TAX CREDIT

September 17, 1984

This supplemental information is in response to the request that witnesses provide descriptions of the specific types of R&D activities for which the R&E Tax Credit was claimed, and the products and services to be affected or created as a result of the activities.

Following is a description of AT&T research and development work and resulting products which qualified for tax credit in 1983.

> SECTION ONE is a general description, with examples, of work in the four fields of special importance: microelectronics, digital systems, photonics, and software systems.
>
> SECTION TWO is a summary of the seven areas of qualifying work at AT&T Bell Laboratories plus summaries of the generally similar work at AT&T Information Systems and at AT&T Technologies.

SECTION ONE

HIGH TECHNOLOGY RESEARCH AND DEVELOPMENT AREAS

INTRODUCTION

The AT&T entities conduct research, develop, manufacture, and market information systems, services and products world-wide. AT&T has a long-established commitment to technical innovation which it has pursued by vigorous scientific research and development. We believe that this kind of effort is essential to further progress in the information industry and that the nation itself benefits greatly from our research and progress.

AT&T Bell Laboratories, in particular, is a major source of telecommunications and information systems technology. For example, during 1983, AT&T Bell Laboratories devoted substantial research and development effort to such fundamental information-age technologies as micro-electronics, digital systems, photonics and lightwave transmission systems, and software systems. This section is a general description, with examples, of work in those four fields of special importance, followed by a discussion of how progress in those fields will contribute to the future.

I MICROELECTRONICS

No technology has advanced faster or contributed more to the expansion of customer choice than microelectronics -- the technology of the very small. Almost since the invention of the transistor by Bell laboratories in 1947, progress in the technology of electronic information management has been measured by the development of ever-smaller and faster-operating circuits.

Making things smaller is not an end in itself. But as the dimensions of microelectronic structures shrink, their costs shrink as well -- while their speed, functionality, and reliability grow.

Even at the current rate of progress -- doubling the scale of component density every eighteen months -- the physical limits of manufacturing and operating such tiny integrated circuits probably will not pose serious problems for the rest of this century. So by extrapolating current trends, we can foresee that continued basic and applied research will result in silicon chips a thousand times more complex and a thousand times faster than today's -- meaning hardware with about ten thousand times more intelligence for the same real cost.

Ultimately, our research may lead to ultrafast chips containing a hundred million components. Such chips, perfectly suited to digital operation, would create an unprecedented potential for synergy between digital intelligence and digital information transmission.

We continue to search for more computing power at lower cost. Among our research efforts are investigations of new semiconductor materials and the unique electronic phenomena that occur at temperatures near absolute zero. Our scientists are attempting to create higher levels of circuit integration, to split computing tasks into pieces for parallel processing, and to build integrated circuits with interconnections as rich as those among nerve cells in the human brain.

From the tiniest component to the largest system, the degree to which modern electronic systems are interconnected, interrelated, and interdependent seems almost overwhelming. Even within individual chips, complexity has grown so great that whole sections are devoted to controlling the flow of data among other sections. On the level of circuit packs, specialized chips often are needed just to manage the flow of information to and from other chips. As examples of this complexity and inter-dependence, consider two recent products of AT&T Technologies, the WE*32100 microprocessor and the 256K RAM.

Smaller than a dime, the WE32100 is a silicon chip that is the functional equivalent of a cabinet-sized computer of only a decade ago. It is ten percent smaller and three times more powerful than its predecessor (the WE32000 microprocessor, the world's first production 32-bit microprocessor). It can access a computer's memory for huge amounts of information, such as the 100 million numbers listed for telephones in the United States. If each of its 150,000 transistors were a house, and the lines connecting them were roads, the features on the chip's surface would correspond roughly to all the streets, highways, bridges, and buildings in Omaha, Nebraska-a city of over 300,000 people.

The 256K RAM, another product of Bell Laboratories research and development, is another electronics industry "first." This random-access memory on a chip, the first of its kind in production, can store more than a quarter-million bits of information -- and make any one of them accessible in 105 billionths of a second. Its memory can hold more than ten closely spaced, typewritten pages of information.

As a result of precise applied research and development work at AT&T Bell Laboratories, the 256K RAM can step right in and

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function in the 3B*20 processor, the "brains" for AT&T's new digital switch, 5ESS* (Number 5 Electronic Switching System). It also can be used for text-editing systems, for controlling manufacturing processes, and for small communications systems. It will help meet future growth needs because it is interchangeable with earlier-generation random-access chips.

The reason for the success of these two chips -- and of the hundreds of other designed and manufactured by AT&T -- is the concentration of AT&T research and development expertise in the physics of materials, in computer-aided design, testing and checking techniques, and in fault-tolerant processing.

Only with the aid of sophisticated computer-based tools is it possible for human beings to design such complex circuitry. Using such tools, our scientists and engineers are now able to design hundreds of chips and thousands of circuit packs yearly. So even though chip complexity has doubled again and again, design automation -- a leading-edge technology its own right-- has made microelectronic intelligence available almost everywhere.

The above research and development work and the resulting products have benefited from the tax credit.

II DIGITAL SYSTEMS

As microelectronics have increased our ability to manipulate information, research and development, especially in digital techniques, has enabled us to move that information in ever greater quantities at ever-reducing costs. From the satellites that link continents to the cables linking central offices to the wires between individual homes and business, the move to digital service is increasing -- and with reason.

The number of conversations that can be carried by a single analog microwave radio channel has about doubled in the past decade. With the application of digital techniques, that number will triple in the next ten years. Digital techniques now are proving economical even on the longest microwave radio routes. At the end of 1983, more than 75% of metropolitan trunking facilities were digital.

AT&T Bell Laboratories scientists and engineers, in an international field trial, tested a new transmission technique that can increase the capacity of international satellite transponders as much as tenfold and thus significantly reduce the cost of overseas satellite transmission. Presently, each transponder has a capacity of 1,200 one-way telephone calls; using the new techniques, as many as 12,000 can be carried. The original technology came from work done on design of terrestrial microwave systems.

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As a result of extensive applied research at AT&T Bell Laboratories, AT&T's new digital inter-office carrier system, T1-G, will provide relief for overstuffed cable systems in metropolitan areas and economical growth for suburban and rural areas. The T1-G digital carrier system doubles the capacity of present T1 digital systems, providing a cost-effective 96 channel facility compatible with other state-of-the-art digital facilities and services.

Digital technology is being used in other ways to bring digital services ever closer to customers. AT&T Bell Laboratories' basic and applied research resulted in the world's most advanced digital switch -- AT&T's 5ESS system, a leading-edge blend of microelectronics, modular hardware and lightwave technologies. A second generation digital switch, 5ESS features distributed architecture, a technique that spreads the system's intelligence throughout the host and remote modules instead of concentrating it in a central processing unit. In addition, 5ESS has modular software and hardware as well. This allows operating companies to enlarge the system as customers are added or to modify it to add additional services.

Using digital electronics, a new Subscriber Line Carrier, SLC*96, provides 96 voice channels with as few as three pairs of copper wires. Regular telephone users are thus getting the benefit of digital technology working with copper cable pairs.

Using optical fibers instead of copper wires, a new SLC system has just gone into service in Chester, Pennsylvania. This system has the same 96-channel capacity as the standard SLC-96; however, it uses two pairs of optical fibers rather than the copper wires. And a forthcoming fiber SLC system will be able to handle the traffic for seven conventional SLC systems -- still with only two pairs of fibers. Leading-edge digital technology is thus combined with widely-available copper cable conductors to provide new, more versatile customer services.

Digital technology is also being used to meet the needs of medium and large businesses that used private lines for data and other non-voice traffic. With Circuit Switched Digital Capability

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(CSDC), a new digital data service, customers use existing copper wires and new digital electronics to establish voice connections in the usual way. They can, however, alternate between voice and high-speed data transmission as often as they like. CSDC data can flow continuously at 56,000 bits -- about one typewritten page -- per second. By switching back and forth between voice and data modes, customers can send a picture or drawing as a facsimile, discuss and perhaps sign drawings, all in a matter of minutes.

With costs of digital processing and digital transmission declining, AT&T's scientists and engineers continue to seek ways in which these increasingly powerful and affordable capabilities can be used to the benefit of everyone.

Deployment of the 5ESS switch is an important step toward ubiquitous digital interconnectivity. Other steps include deployment of computer-managed intelligent, high-speed digital transmission systems and packet-switched systems. Together with existing digital systems such as the high-capacity 4ESS* switch, these new systems are speeding progress toward a flexible, cost-effective Integrated Services Digital Network. Such an intelligent network will open opportunities for new efficiences and new services, allowing customers to exchange information in any form -- voice, data, even video-- as easily as they might dial a telephone call.

III PHOTONICS AND LIGHTWAVE SYSTEMS

Less than a decade ago, fiber optics was an emerging technology. Today, due to intensive research and development, lightwave communications is the transmission system of choice worldwide and the acceptance of lightwave systems is unparalleled in the history of transmission technology.

Lightwave communications systems -- in which flashes of light carry information through hair-thin glass fibers -- promise to reduce costs of transmission for a variety of reasons: (1) they are digital systems, (2) they carry much more information for a given size cable, (3) the need for signal regeneration is reduced, and (4) they are immune to electrical interference. However, this entirely new mode of communications would not have been possible without prior basic research on the transmission of light in ultra-thin glass fibers and the generation of the light by lasers and light-emitting diodes. Much of the research for optical communications, including the discovery of the laser phenomenon, took place at AT&T Bell Laboratories.

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Just as important, basic and applied research in progress is expected to lead to a twenty-fold increase in transmission rates -- to 1.7 billion bits per second-- before the end of the decade.

Both the rate at which information can be sent through lightwave fibers and the distance the information can travel without amplification have increased dramatically. In fact, the product of rate and distance is doubling yearly -- and this probably will continue for the rest of the century. Lightwave now is being used to send high-speed information across neighborhoods and continents -- and soon under the ocean as well. Recently our scientists set a new world's record for both distance and capacity by sending laser-generated light pulses through 100 miles of glass fiber without amplification. The amount of information transmitted without error in one second -- 420 million bits-- was equal to the entire text of a 30-volume encyclopedia.

As new lightwave components are being developed, the increasing integration of lightwave and electronic elements promises future expense reductions. Our scientists and engineers continue to stretch the information-carrying capacity of lightwave systems.

Telecommunications companies now have more than 60 lightwave systems in operation. Initially, use of lightwave technology was for interoffice transmission. Now however, there are applications in the loop plant, for connections within switching systems, and for links among computers and peripheral devices.

When equipment shipped in 1983 has been installed, AT&T has equipped more than 170 lightwave routes, serving more than 8.5 million voice circuit miles. The world's longest lightwave cable route, stretching 776 miles from Massachusetts to Virginia, contains ultra-pure glass fibers, each one of which can transmit 1,344 conversations.

Lightwave systems are also being installed undersea. AT&T Communications has been awarded a major portion of the contract to design and construct the first transatlantic lightwave cable system, known as TAT-8. The AT&T section of the TAT-8 undersea cable system was designed by AT&T Bell Laboratories to operate under water for 25 years with at most two shipboard repairs due to component failure. The system also will be able to predict potential service problems so that they can be corrected ahead of time.

When ready for service in June 1988, TAT-8 is expected to provide the equivalent of approximately 40,000 two-way telephone conversations.

Research into lightwave continues at AT&T Bell Laboratories where photonic components and subsystems are designed to function together to provide lightwave systems of maximum capacity, reliability and compatibility.

One of the basic research discoveries that made possible today's lightwave communications is the modified chemical vapor deposition (MCVD) process. This is a method for controlling the chemical composition and, therefore, the transmission characteristics, of glass fibers. Discovery of the principles of the MCVD process was made by AT&T Bell Laboratories scientists whose major expertise was not the chemistry of glass, but who understood silicon and solid state devices. This information was made widely available and today at least ten manufacturers use methods based on this discovery.

AT&T Bell Laboratories researchers recently discovered how to use a phenomenon called solitons to greatly increase the information carrying capacity of lightwave transmission systems. Solitons are special kinds of waves that retain their shape even for very short pulses, thus reducing loss of information during transmission.

The researchers showed how solitons can be used to transmit information at a rate of 100 billion bits per second, an improvement by a factor of 300 over the best current transmission rates in optical fibers. If the promise of these discoveries is realized it will make it possible to greatly expand the capacity of lightwave systems by changing the electronics with no need for installation of additional lightguide cables. Publication of the work means that the ideas are available for use by all suppliers of lightwave transmission systems.

Working in photonics, AT&T Bell Laboratories scientists have done research on a new type of laser, the free electron laser, capable of producing pulses very much shorter than other lasers now available. The pulses from this laser are 10 to 40 picoseconds long (a picosecond is one millionth of one millionth of a second). This laser aids AT&T Bell Laboratories physics research projects such as the investigation of transient phenomena in solids. It is used, for example, to measure electron recombination in superconductors, emission of photons, and the decay of short-lived impurity states. The original concept for the free electron laser came from Stanford University. This work is an example of how the participation of AT&T Bell Laboratories scientists in the scientific community results in a two-way flow of ideas, to the benefit of AT&T Bell Laboratories research activities and ultimately to the benefit of telecommunications users.

IV SOFTWARE SYSTEMS

As software and the related hardware grow rapidly in complexity and power, our scientists and engineers are devising new ways to make the complex easy for people to work with. They do it by increasing standardization and by developing computer aids to help design and test software. We are also developing new and more powerful algorithms to solve complex computational problems, as well as logical systems to unify the functioning of many separate computers.

How does it work? The software that runs AT&T's 1A ESS* switch, for instance, contains several million program statements that each second control millions of concurrent and overlapping transactions. Yet the reliability of this huge set of software is nearly perfect. The system it runs is designed to be about one thousand times more reliable than typical commercial computers -- even while smoothly accommodating the almost constant changes needed for technical upgrading, growth and new service features for customers.

The same kind of attention and care went into the software for AT&T's 3B family of high-performance, versatile computers. One member of the family is the 3B20 computer, "brains" of the new digital 5ESS switch. A new addition, and a version of the 3B20 that drives the 5ESS switch, is the 3B20A, an extremely cost-effective extension of the general-purpose 3B20S. Other members of the 3B family, all tailored to the flexible UNIX** operating system, include the ultra-reliable 3B20D computer, widely used in network switching equipment, and the smaller 3B5, designed specifically for office applications.

One indication of progress in software is the enthusiasm with which the flexible UNIX computer operating system is being adopted worldwide. The UNIX system, whose modular structure allows programs to be put together almost like building blocks, is fast becoming the standard for the high-performance microprocessors and minicomputers of many manufacturers.

In addition to its licensing and support of the UNIX operating system, AT&T recently began licensing and supporting UNIX system software, including the WRITER'S WORKBENCH* programs for setting up and correcting written material, and the INSTRUCTIONAL WORKBENCH* programs for teaching via computer terminals. A few years ago the cost of using computers to perform these kinds of tasks would have been prohibitive.

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Because of the advances in software and computer systems, people might soon be able to communicate with machines the same way they communicate with other people: by talking. Growing understanding of digital voice processing and automatic speech recognition raises the possibility of practical new services based on voice input and output. Systems that recognize isolated words now are so reliable that we are considering them for use in telephone equipment. Such systems might one day allow people to operate machines through oral commands, or create and edit text merely by speaking.

But recognizing whole sentences takes about 100 times more processing capability than isolated words. A promising approach to providing such vast processing power economically is to replace large, general-purpose computers with smaller, highly specialized ones. So just as today's typical home contains dozens of specialized electric motors, each devoted to a single appliance or task, tomorrow's home may contain dozens of specialized computers for applications such as recognizing speech.

Even more difficult than recognizing words or sentences is understanding their meaning. In order to understand naturally spoken language, machines must be able to tolerate ambiguity and make judgments -- such as the difference between "to" and "two" -- based on knowledge about the task to be performed. In a sense, the machines must be "artificially intelligent."

Already, "artificial intelligence" systems can imitate some aspects of human intellectual behavior. For instance, the ACE system, developed by AT&T scientists and engineers, now troubleshoots almost a million customer lines in Southwestern Bell. Rather than following a predetermined sequence of steps, as a conventional computer-based system would, ACE queries the company's existing data base to find past patterns of cable troubles, then analyzes the patterns using the know-how of the human cable analysts who helped program it.

As computer power grows, such "expert" systems have the potential to make human-like expertise -- from legal and financial advice to medical diagnosis -- convenient and inexpensive.

V TECHNOLOGY FOR TOMORROW

While increasing computing power can help make machines smarter and friendlier, the increasing capacity and intelligence of transmission systems can help make them more useful. For example, high-speed digital transmission may make it economical to move from a communications technology that is largely audio to one that is both video and audio.

Video conferencing services already are saving travel time and making long-distance meetings more effective. Eventually, video communications and pictorial data bases may become as widespread as today's telephone service.

Digital lightwave transmission systems potentially have even more prodigious information-carrying capacity. Experimental lightwave systems, for instance, now can carry billions of bits per second -- far more than a human being can absorb in data or even video form.

In addition to carrying pictorial information for viewing by people, such vast information-carrying capacity will be used to carry high-speed data for digestion by machines. Intelligent machines could comb huge quantities of transmitted data, selecting and storing only the particular information -- the news item, movie, stock quote, or message -- that fits their users' needs or interests.

The bits of digital information traveling through the telecommunications network already are being handled more efficiently by intelligent transmission systems. These systems provide telecommunications companies with new efficiences and new services, and give business customers more control over their own services.

But it is not just in moving information that the potential lies. There is opportunity to use that information and apply the computer and communications technology of the Information Age to improve productivity in a variety of areas.

In today's modern offices, computers have demonstrated their ability to improve productivity and to speed the flow of vital information.

Improvements are not limited to offices. The high technologies of the Information Age can raise the productivity of all industries, from manufacturing to transportation to agriculture. Advanced technology can supplement these industries, but it cannot replace them. In a world approaching six billion people, many mired in poverty and all driven by expectations that have been raised by modern communications, demand for material goods will continue to strain our physical resources and our environment. Yet technology can increase vastly the efficiency and effectiveness with which human needs are met. It can help to expand all our resources: land, energy, minerals, even time.

Our own industry offers a good example of what can be done. We have seen silicon chips replace tons of steel, as electromechanical relays were supplanted by microprocessors. Hair-thin glass fibers have replaced heavy copper cables. And we have seen communications virtually conquer distance, turning hours or days of transit time into split-second travel near the speed of light. So even in a world of finite resources and growing demand, we can hope for increased material well-being worldwide.

In the future we may see the development of pocket-sized terminals that provide their users with virtually any information they might want -- from the resources of the world's great libraries to up-to-the-minute changes in the local TV schedule.

For the future, we envision a combination of complex technologies linked in a systems approach to expand the range of alternatives available to telephone companies and their customers.

SECTION TWO

PROGRAM DESCRIPTIONS

I BASIC RESEARCH

At AT&T Bell Laboratories, basic research seeks new knowledge in scientific fields relevant to communications. Basic research activities which qualify for the R&E Tax Credit can be described in four broad categories:

A PHYSICS
B MATERIALS SCIENCE
C COMMUNICATIONS SCIENCES
D INFORMATION SCIENCES

I-A PHYSICS

Research in physics emphasizes the search for information in that field which will benefit telecommunications. The goal is to create fundamental knowledge:

- through in-depth investigation of the electrical, magnetic, and optical properties of solids, liquids, and gasses;
- through improved understanding of the interaction of photons, electrons, positrons, phonons, and neutrons with materials;
- through the discoveries of new principles of the physics of materials and the synthesis of new materials;

- through advances in understanding the physics of electronic and photonic devices;
- through discoveries of new device principles; and
- through discoveries of novel fabrication techniques for material structures possessing unique properties.

Further, the work is aimed towards fostering close and continuing contacts with world-wide physics research related to communications in order to make rapid and effective use of new scientific knowledge.

Research provides scientists with a better understanding of physical phenomena and the principles of physics. This knowledge can be used by others, in turn, to improve service, either directly or by advancement of the field of telecommunications with the ultimate result of improved communications at reduced prices.

I-B MATERIALS SCIENCE

Research in materials science covers fundamental work on materials which may be of future importance in telecommunications. The program includes investigations of organic compounds, polymer compounds, solid state materials, metals, alloys, ceramics, and glasses.

Research in materials science emphasizes investigations of the bulk and surface properties of materials which are critical to the performance of telecommunications systems that use the materials. The work provides knowledge about stability and other characteristics of materials which is needed for innovation in information systems technology.

I-C COMMUNICATIONS SCIENCES

Research in communications sciences focuses on those fields of science and practical technology which show the most promise of aiding the progress of telecommunications. Current work emphasizes:

- radio research;
- lightwave technology;
- new devices for telecommunications;
- computer systems technology; and
- computer systems concepts.

Research in communication sciences ensures progress in technological fields important to telecommunications. The work provides knowledge which is of immediate use by making available better information for improving the use of existing systems and for planning future systems.

I-D INFORMATION SCIENCES

Research in information sciences encompasses:

- speech and acoustics;
- computing science;
- mathematics and statistics; and
- operations research.

The research provides information which allows telephone companies to reduce training costs, increase the effectiveness of employees, provide for more effective use of computing facilities, take advantage of modern mathematical and statistical techniques, and, in general, operate more efficiently.

II GENERAL RESEARCH

General research is work intended to find new knowledge concerning the devices, components, and systems used for telecommunications. It seeks to stimulate innovation by coupling the scientific findings of basic research to the general needs and opportunities of the real world of telecommunications. The general research activities at AT&T Bell Laboratories which qualify for the R&E Tax Credit can be described in four broad categories:

A ELECTRONICS TECHNOLOGY
B SWITCHING SYSTEMS RESEARCH
C TRANSMISSION SYSTEMS RESEARCH
D OPERATIONS SYSTEMS RESEARCH

II-A ELECTRONICS TECHNOLOGY

Research on electronics technology is work intended to provide new knowledge which will be a basis for advances in the technology of telecommunications, especially microelectronics. The emphasis is on integrated circuits, especially information processors, light-emitting diodes, solid state lasers, photo-diode detectors, and other devices relevant to telecommunications.

There has been continued progress on new methods to achieve higher speeds, smaller sizes, and greater reliability in solid state electronic devices. For example, reliable processors have been fabricated with very small component feature sizes and spacings, e.g., fractions of a ten-thousandth of an inch. Also, reliable high-speed lasers have been made from high-purity compound-semiconductor materials.

II-B SWITCHING SYSTEMS RESEARCH

Switching systems research is intended to provide information on new system, hardware, and software architectures for future generations of switching systems. Examples include investigations of

- switching systems interfaces for new types of customer services, such as simultaneous voice and data communication,
- software technologies that improve the entire switching software cycle from design through testing, and
- integrated voice/data service capabilities including fast packet network architectures, low bit-rate voice transport, and new data service network opportunities in an Integrated Switched Digital Network (ISDN) standard environment.

Achievements of this program in 1983 included demonstration of high-quality transmission of 32 kilobit/second packetized voice on a 1.5 megabit/second line with 140 (simulated) simultaneous callers, construction of an experimental wideband fiber-based testbed for the integrated switching of video, data, and voice, and evaluation of architecture and experimental software for a high query-rate data base system.

II-C TRANSMISSION SYSTEMS RESEARCH

Transmission systems research covers activities aimed at generating and exploiting new technology for application to transmission systems and to new transmission services. Typical activities include investigations of

- application of digital signal processing and VLSI (Very Large Scale Integration) in transmission systems,
- propagation limitations to the performance and capacity of digital radio systems, and
- the principles and fundamental properties of lightguide cable structures, materials, and components.

Recent accomplishments of transmission systems research include hardware demonstrations of a new digital coder for voice signals, a VLSI realization of an echo canceler, determination of the effect of space diversity on the distance dependence of amplitude dispersion in radio transmission, and establishment of the optimum lightguide geometry and composition for simultaneous transmission on the 1.3 and 1.5 micron (wavelength) optical windows.

II-D OPERATIONS SYSTEMS RESEARCH

Operations systems are computer-based systems that telephone company employees use to support operations activities. An operations system does not directly provide service to customers, but rather supports company personnel in the performance of their duties, such as testing trunks or maintaining switching systems. Operations systems research is intended to provide information which can be used to improve the procedures, software or hardware of such systems, or to create new systems. The work emphasizes work on technologies and methods which are relevant to operations systems, and the adaptation of the technologies and methods to make them optimally suitable. Examples include investigations of software building blocks and techniques for advanced computing environments, new computing architectures and database organizations, and network techniques which should allow the systems to work together for improved performance and efficiency.

Typical outputs of the program are proposals for new loop testing systems for pair-gain systems, models for evaluating new software structures and various organizations of computers and company personnel, evaluation of the use of networks of advanced computer workstations, and evaluation of the impact of new database machines on established operations systems.

III BASIC TECHNOLOGY

Basic technology includes devices, components, and systems such as integrated circuits, ferrite devices, sealed gas surge limiters, semiconductor diodes, transistors, microwave integrated circuits, piezoelectric devices, magnetic bubble memories, lightwave sources and detectors, optoelectronic devices, liquid crystal displays, and printed wiring interconnections, as well as processors, energy systems, software systems, and other common systems.

The basic technology activities at AT&T Bell Laboratories which qualify for the R&E Tax Credit can be described in four broad categories:

A INTEGRATED CIRCUITS
B GENERAL DEVICES
C COMMON SYSTEMS
D PROCESSOR AND COMMON SOFTWARE SYSTEMS

III-A INTEGRATED CIRCUITS

The general goal of integrated circuit R&D is the development of new technologies to extend the capabilities of these devices to higher densities, higher speeds, higher voltages, and lower power consumption. Typical activities include improvement of fabrication technologies such as mask generation and photolithography, development of improved design techniques, especially Computer Aided Design (CAD) and design of special integrated circuits optimized for specific systems applications, and fabrication of experimental models and prototypes.

The products of this work are new generations of integrated circuits on silicon chips, each improved over its predecessors. Recent achievements include the world's first production 32-bit microprocessor which contains 150,000 transistors on a single chip, and a memory chip with a storage capacity of 256,000 bits.

III-B GENERAL DEVICES

Device R&D at Bell Laboratories includes work on many other types of devices in addition to the silicon integrated circuits discussed above. Of particular importance are magnetic devices, microwave circuits, and, most recently, the broad class of devices which combine electronics with photonics (lightwaves and optics). The latter include lasers, light-emitting diodes, photodiode detectors, optoelectronic devices, and liquid crystal displays.

The product of the device R&D program is a continuing flow of new and improved high-technology devices and components. One recent achievement is a new laser which operates at longer wavelengths and therefore exploits reduced attenuation of lightwave fiber materials, but which preserves the long life and reliability of previously developed lasers. Another new type of laser is the "cleaved coupled-cavity laser", a pure single-frequency tunable laser. A third recent achievement is a new type of high-speed, low-noise avalanche photodetector diode which is made possible by the combination of design using band-gap engineering and fabrication using molecular-beam epitaxy.

III-C COMMON SYSTEMS

A "common system" is one that provides common power, interconnection, or environmental support for network elements associated with transmission and switching; for example, power systems, distributing frames, and equipment-building systems. R&D effort has been especially intensive on power systems and interconnection technology.

Examples of the products of the program are

- -new types of reliable connectors for coupling electronic equipments,
- -improved materials and fabrication processes for printed wiring boards,
- -new components and designs for electronic power supplies,
- -power supplies optimized for individual new systems or classes of systems,
- -improvements of batteries for central office use,
- -building alarm and energy management subsystems, and-building bracing specifications for earthquake protection.

III-D PROCESSOR AND COMMON SOFTWARE SYSTEMS

Processor R&D covers the development of a technology system for processor hardware design including silicon circuit design and fabrication, packaging, CAD, and design process development. It includes the basic development and engineering of the 3B family of processors, as well as forward-looking work in areas of VLSI processor architectures, investigations of new processor architectures such as distributed processors, and systems physical design. Common software systems work emphasizes development and support of the UNIX system, including UNIX system networking and database systems, systems software packages, and related products.

Typical examples of the outputs of this work are

- -design of the hardware, firmware, diagnostics, and the UNIX operating system software for the 3B5 Processor,
- -development of the 3B2 Processor, and
- -planning, development, and delivery of new software and operational features for the UNIX system, and
- -development of computer aids for the design, analysis, and testing of telecommunications hardware subsystems.

IV LOCAL AND EXCHANGE NETWORK

The 1983 network projects at Bell Labs reflected the needs of both AT&T and the divested Bell Operating Companies related to the provision of telecommunications services during and after the restructuring of the telecommunications industry. Work was performed to define new services, network capabilities and equipment requirements. Design and development was undertaken of hardware and software to provide new capabilities for systems currently in service in the operating companies and for new systems.

Work at Bell Labs on switching and transmission systems used for local and exchange networks which qualifies for the R&E Tax Credit can be described in the following categories:

A ELECTRONIC SWITCHING
B BILLING SYSTEMS
C EXCHANGE TRANSMISSION SYSTEMS
D TRANSMISSION CABLES
E LOOP SYSTEMS
F CELLULAR MOBILE SYSTEMS

IV-A ELECTRONIC SWITCHING

Engineering work was undertaken to formulate requirements for new switching systems and to provide new features on existing systems. Generic requirements applicable to local switching systems specify performance capabilities and interfaces with the telephone network, with customer premises equipment, and with remote centralized maintenance and operations support systems. Examples of engineering results produced in 1983 include specification of features for equal access to the local exchange networks by competing interexchange carriers as required by the FCC and the courts, reliability requirements, acceptance test criteria, and loop interface specifications for the electronic systems that are being introduced in the loop plant between the central office and the customer.

Design and development projects provided features for new customer services and for more efficient network operation. New software released in 1983 for the 1/1A ESS switches, used widely in metropolitan areas, provided new testing and maintenance features, new capabilities for Centrex customers, a digital data transmission service, and switching capabilities to provide cellular mobile services. Also, development was completed on "equal access" software to allow customers to gain access to multiple interexchange carriers, to be installed starting in 1984. New software for the 2/2B ESS* switch, used in suburban areas, to provide "equal access" features was designed, its development will continue in 1984 and will be available for service in 1985. The new modular digital switching system, the 5ESS system, had its first multi-module office operational in 1983; ongoing design and development of new hardware and software features will provide for advanced customer services, increased switching capacity and additional maintenance and operational capabilities.

IV-B BILLING SYSTEMS

Investigations were conducted to specify requirements for new and existing billing systems related to the introduction of new network services, the restructuring of the telecommunications industry and the wider implementation of measured service replacing flat rate service in local networks. Requirements cover switching systems features, transmission and processing of the billing data and billing validation procedures.

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IV-C EXCHANGE TRANSMISSION SYSTEMS

Laboratory and field characterization experiments were conducted for digital carrier systems on wire cable and on lightwave fiber. Results were a definition of system characteristics for a metropolitan lightwave product line and error rate performance projections for use in tariff specifications for new data services. Evaluations were made of digital signal processing techniques for efficient utilization of digital transmission systems for voice and for video signals; plans were prepared for the introduction of low bit-rate voice techniques into the network. System requirements were defined for new electronic terminals and crossconnect systems for flexible and economic provision of digital special services to customers.

Development of new higher capacity digital carrier systems operating on wire cables that were previously used with 24 channel systems, resulted in the design of a 96 channel system which is now ready for manufacturing. Design and development of new terminals for both digital carrier and metallic transmission facilities was completed. These terminals introduced large-scale integrated circuits and microprocessor control into transmission equipment, thus achieving both low first cost and major operational savings in the provision of special services. Development of additional features for the Digital Access and Cross-connect System (DACS) continued. The new features provide circuit conferencing, efficient interconnection of multiple systems and more advanced maintenance capabilities.

IV-D TRANSMISSION CABLES

Transmission cables use either insulated copper wires or glass fibers for transmission between switching offices (trunk cable), from switching offices to customer premisses (loop cable) and for intrabuilding applications. Work was performed to investigate more efficient transmission of digital signals on loop cables, to define requirements for copper and lightguide cable splicing, and characterize combustion and corrosion of materials used in cables.

Development work resulted in the design of hardware for splicing single mode fiber in the factory and for field repair, evaluation of new fiber designs afforded by alternative fabrication processes and the optimization of materials to retard the flammability of cable products.

IV-E LOOP SYSTEMS

Loop systems are used to connect a customer premises to the local switching office. Experiments and laboratory demonstrations were performed on new system concepts using existing and new transmission media for providing voice, data and video services. Requirements were specified for the next generation of loop carrier systems. Requirements for underground structures and cable placing methods for fiber systems were specified. Noise and electrical protection considerations related to lightning and electrical power faults were investigated to provide guidelines for equipment design and for network layouts.

Additional environmental testing of the currently available digital Subscriber Loop Carrier (SLC-96) was continued to improve its design reliability. The next generation system (SLC-5) is being developed to meet new service needs; it will have improved capabilities for the provision and maintenance of special services. Development of a fiber carrier system for loop applications led to initial manufacture of the system in 1983. Development continued on improved enclosures, terminals, interfaces and protection apparatus for aerial, buried and building cable systems.

IV-F CELLULAR MOBILE SYSTEMS

Hardware and software for the cell transmitter-receiver systems and for the switching offices passed final system verification for functionality and call capacity. The first commercial system went into operation in the Chicago area in 1983; it had 17 cells. Based on the results of previous work, design of a next-generation small-cell system was completed. Functional requirements were specified for new features to be implemented in the next software release. New technologies and techniques are under investigation to increase the number of channels and to provide data communications and privacy. Propagation measurements were made and methods for planning and engineering of cellular networks were documented.

V INTERCITY NETWORKS

Intercity network R&D at Bell Labs includes evaluations of potential new services, network capabilities, and equipment requirements, together with design and development of new hardware and software systems, especially switching and transmission systems. Work which qualifies for R&E Tax Credit can be described in the following categories:

A TOLL ELECTRONIC SWITCHING
B STORED PROGRAM CONTROL NETWORK
C DATA NETWORKS
D OPERATOR SERVICES
E INTERCITY TRANSMISSION SYSTEMS
F SATELLITE & UNDERSEA CABLE SYSTEMS

V-A TOLL ELECTRONIC SWITCHING

Work was undertaken to provide planning and requirements definition of new features and capabilities for toll switching systems and metropolitan tandem systems, as required by post-divestiture network constraints. Investigation of new network services includes analysis of controlled introduction, in order to identify operational and customer problems. In 1983, controlled product tests were underway for Audio Teleconferencing and Audio Graphics Teleconferencing.

Design and development of new hardware and software features for the 4ESS switch continued. Features released for service in 1983 included call routing capabilities to implement a new intercity network structure using "Dynamic Nonhierarchical Routing", improved operations and maintenance capabilities, and new customer services including international audio teleconferencing and national graphics teleconferencing. Software under development for service in 1984 will provide the features needed by Bell Operating Companies to use the 4ESS system as an Access Tandem and those needed by AT&T to use it for domestic intercity service and as an access point for international carriers. New hardware is being designed for interfacing to digital transmission systems.

V-B STORED PROGRAM CONTROL NETWORK

A signaling network linking the stored program processors of the toll switching offices carries the information required to set up, route and bill calls in the AT&T network. It provides the network with the flexibility for new customer services, high network utilization and reliable service in the presence of overloads or equipment outages. Engineering analysis continues to provide the necessary planning for the evolution of the signaling network and to provide design requirements for its switching and transmission systems.

Development projects are in progress to provide new equipment and software capable of operating with both the existing signaling formats and with the new common channel signaling protocols, to provide a new type of high-capacity Signal Transfer Point switch for the signaling network, and to develop new software for the Network Control Point for implementation of dialed services requiring access to a customer data base. Network capabilities for new voice and data dial-up services are being developed, some of which previously required special services circuits.

V-C DATA NETWORKS

Engineering evaluations of a class of data communications services to be provided by a network of packet switches included definition of the data service and specifications of operations plans, of network capabilities, and of requirements for the packet switch.

The system architecture defines hardware and software versions, and provides for introduction of successively larger sets of features with higher performance and reduced costs. In 1983, an early version of the system was in field test, and development was continuing on more advanced versions.

V-D OPERATOR SERVICES

Engineering work was directed to identifying new capabilities for operator systems to meet post-divestiture needs, to reduce operating expense, to improve service, and to support operator functions of new services such as teleconferencing.

Development of new features for the Traffic Service Position System resulted in the first application of visually impaired operator arrangements and the network-wide availability for Automated Calling Card Service, in 1983. Features related to the post-divestiture operation were under development for service in 1984.

V-E INTERCITY TRANSMISSION SYSTEMS

Engineering tests were conducted on long haul lightwave and digital radio systems. Radio performance limitations imposed by propagation phenomena and by the interference environment were measured and offsetting compensation techniques were evaluated.

Advanced digital radio system development will increase the traffic capacity over that available currently by using dual polarization and increasing the number of modulation levels, and will decrease the effects of fading with advanced equalizers. Propagation test range evaluation of prototype equipment was conducted in 1983. Development of digital transmission equipment continued with the design of improved digital-to-analog converters, echo cancellers, low bit-rate voice and data multiplexing terminals. Development of lightwave transmission systems introduced systems with increased capacity using 3-channel wavelength-division multiplex, and work continued on systems using much higher bit-rates than those used currently.

V-F SATELLITE & UNDERSEA CABLE SYSTEMS

Analyses of satellite technology were conducted to identify digital capacity limitations of transponders and define new services that draw upon the unique capabilities of satellites.

Earth station communications systems and control software were developed to implement the Digital Satellite Network using Agile-Trunking under the control of a Satellite Network Controller. Development of Telstar 3 was completed with the first satellite (Telstar 301) launch in 1983. This system has a greater capacity and longer life than previous communications satellites, resulting from the use of highly linear solid state devices in the transponder and an improved life energy-storage system.

Development of a high capacity lightwave undersea cable continued with investigation of technologies for single mode fiber splicing, cable design for undersea operation and the evaluation of high speed repeaters, regenerators and terminals. Development of a dynamic bit allocation multiplex will provide a 5:1 compression of voice circuits, further increasing system capacity.

VI NETWORK OPERATIONS

Operations systems are computer-based systems that company personnel use to support operations activities such as planning, engineering, equipment assignment, maintenance, monitoring, and control of the telecommunications network. Operations plans include functional descriptions of operations systems and the interrelationships among operations systems, together with descriptions of the work centers where the operations are performed. The network operations work qualifying for the R&E Tax Credit is described in six categories:

A ENGINEERING AND PLANNING
B DISTRIBUTION SERVICE
C SWITCHED SERVICE - FIELD OPERATIONS
D SWITCHED SERVICE - AREA OPERATIONS
E SWITCHED SERVICE SUPPORT
F PUBLIC SERVICES

VI-A ENGINEERING AND PLANNING

Technical planning work for Network Operations examined the roles of intelligent terminals in future operations systems and incorporated divestiture related revisions in the existing network operations plans. Operations planning continued for automated provisioning of special services.

Network Switching Engineering Centers design local and toll switching offices to meet anticipated service demands with the aid of several operations systems, which are continually being enhanced or replaced with newly developed systems. This project developed a system called Digital Ordering and Planning System, a centralized time sharing system for planning and sizing 5ESS switching equipment and for mechanized preparation of traffic and equipment orders. Other work included design of new traffic engineering rules and procedures for estimating the capacities of 5ESS and Local Area Data Transport packet switching systems.

VI-B DISTRIBUTION SERVICE

Distribution systems are that part of the telephone network that connects the subscriber to the local switching center, the central office. It is a complex and changing part of the network that is increasingly being managed with the aid of mechanized operations systems. The Cable Repair Administrative System was expanded for use with Subscriber Loop Carrier systems and to monitor cable pressure alarms. Development began on ACE, a mechanized expert system for the diagnosis of cable troubles. Expert systems contain and make use of knowledge of experienced technicians that would take many years for new people to learn. Cable Administration and Maintenance Operations System software and hardware collects, screens and analyzes cable troubles. Mechanized Loop Testing systems verify subscriber transmission conditions and characterize cable problems. The Loop Maintenance Operations System stores customer records and produces summary information for monitoring response to reports of troubles. The Facilities Assignment and Control System (FACS) maintains inventory and assigns outside plant and central office facilities. Components of FACS are Computer System for Mainframe Operations for mechanized mainframe assignment record keeping, Loop Facilities Assignment and Control System, Premises Information System, and Service Order Analysis and Control. These and other distribution operations systems undergo continuing evaluation to identify the impact of changes in technology, such as the use of digital transmission and lightwave cables, and to find new ways to increase productivity by mechanizing the work of operating the distribution plant.

VI-C SWITCHED SERVICE - FIELD OPERATIONS

The switching control centers provide remote control of the operations and maintenance of switching, trunk, switched special services and billing equipment in stored program-control central offices. Hardware and software development of modern processing and data communications equipment for Switching Control Center System (SCCS) continued.

Requirements were established to accommodate new network systems inputs into the Total Network Data System, which processes network usage data to provide reports for office equipment engineering and administration.

Development continued on the Remote Memory Administrative System, which translates recently received service orders and other inputs that require changes in the electronic switching system memory.

Another development resulted in new features for Circuit Maintenance System-1 (CMS-1) which supports all the trunk related maintenance and installation activity for the 4ESS toll switches. CMS-1 interfaces with other software systems such as databases and automatic testing and analysis systems.

Systems engineering defined manual and mechanized interfaces between main frame and special service centers. Mechanized FACS interfaces for service orders, work orders, and central office inventory data were recommended for improving the productivity of operations.

VI-D SWITCHED SERVICE - AREA OPERATIONS

This systems engineering project provides technical planning for mechanizing the records and administration functions associated with special services such as Private Branch Exchanges (PBX) and Wide Area Telecommunications Service (WATS) and 800 service. Several computer systems are used. Circuit Maintenance System-3 provides installation and maintenance records for special services and it interfaces with trunk records contained in Trunks Integrated Records Keeping System (TIRKS).

Another system, Switched Access Remote Test System (SARTS), is being modernized for digital transmission systems. This entails new development of the Process Controller which is the minicomputer system that controls SARTS. In the network, trunks connect switching offices with one another. Centralized Automatic Reporting on Trunks (CAROT) is an operations system for centralized remote testing of signaling operation and transmission performance of trunks. New developments include a TIRKS/CAROT record update interface.

The T-Carrier Administration System supports the Facility Maintenance and Administration Center in controlling the digital network. New developments include software for Integrated Special Services Network and engineering evaluation of operations with the new class of processor controlled digital terminal equipment.

VI-E SWITCHED SERVICE SUPPORT

Development is underway for a new national network management system for use with Dynamic Nonhierarchical Routing (DNHR). DNHR is a major improvement in routing calls that will replace the traditional use of a hierarchy of switching centers. Requirements were defined for network management functions for new network service capabilities used in providing new services such as Enhanced 800.

Development continued on ways to accommodate new types of switching and signaling in the Engineering and Administrative Data Acquisition System (EADAS) a traffic measuring system. New features for reporting troubles and assessing service quality were added to the operations system called Network Service Center System, which is used in the Network Service Centers, whose function is to assure the overall quality of service.

Telemetry provides the means for monitoring equipment operation at a remote location. Recent developments provided software and hardware for a Digital Alarm Scanner and an Advanced Telemetry Processor, which are used in surveillance and alarm systems.

VI-F PUBLIC SERVICES

Public services include telephone directories and public telephones. System engineering and development activities provided operations systems for automatically updating directories by means of a computer tie in with customer service order records. A new software system called Station Management System represents an application of computer technology to public telephone system operations.

VII NETWORK PLANNING

Work at Bell Labs on Network Planning, which qualifies for R&E Tax Credit, can be described in the following categories:

A DIGITAL NETWORK SERVICES PLANNING
B NETWORK CONFIGURATION PLANNING
C SPC NETWORK PLANNING
D NETWORK PERFORMANCE

VII-A DIGITAL NETWORK SERVICES PLANNING

The objective of this activity is to formulate a network services architecture that meets the future needs of the business customers for integrated voice, data and video communications. Work was continued to establish an implementation plan for the Integrated Services Digital Network (ISDN), considering both the divestiture-created boundaries and the need for international compatibility. Examples of issues considered were digital network synchronization and protocol requirements for Local Area Network access to the Integrated Services Digital Network.

Design was completed for multilocation video conferencing services, the Circuit Switched Digital Capability for high speed data communications, and the Local Area Data Transport. Planning continued on improved services, including secure voice services, for the military and other government agencies.

Analyses were conducted to define a special services network architecture based on available digital technologies and to recommend network interfaces between the Bell Operating Companies (BOCs) and the intercity carriers. Planning continued on new digital loop services and on alternative implementations of the loop networks such as radio, fiber or coaxial cable.

Protection and compatibility requirements were formulated for interface standards submitted to regulatory bodies and industry groups.

VII-B NETWORK CONFIGURATION PLANNING

Work included analysis of call routing strategies and forecasting methods for the trunking requirements in the intercity public switched network. Computer programs were designed for traffic network planning, toll switch planning, trunk forecasting and trunk servicing under Dynamic Nonhierarchical Routing in the post-divestiture intercity network. Network design rules for new specialized services, such as Circuit Switched Digital Capability and private software defined networks on the public switched network, were formulated and implemented in software for use in network planning. Methods to analyze and forecast demand for special services were designed and integrated with the equipment planning process. Effort was initiated on the planning and engineering methods for Packet Transport Networks and Local Area Data Transport networks.

Network application guidelines for new technology interoffice transmission systems were formulated based on the analysis of capital and operational costs, service capabilities and cross-impact with local digital switching and digital loop carrier deployment. Effects of low bit-rate voice coding and Dynamic Nonhierarchical Routing on the demand for long haul transmission needs were analyzed.

Requirements for computer-based systems to support planning the expansion and modernization of transmission facilities networks were defined. The work consisted of engineering analysis, design of planning algorithms and prototype system implementation for user evaluation on actual network planning tasks. Work continued on the development of an advanced computer-based system for intercity facilities planning with the design of a planning database, an Interactive Planning Work Station and efficient algorithms for capacity expansion in response to forecasted circuit demand and the multiplexing of the circuits onto the broad-band facilities.

Work was initiated on a new network planning system for facilities of the divested Bell Operating Companies (BOCs). Also, new features were designed and implemented in existing systems in support of planning the transition to separate networks following divestiture, as well as to provide the features needed to plan new special services networks using the Digital Access Cross-connect System.

Engineering analyses were made of application of new technologies in local switching, such as distributed switch architecture using remote switching modules and packet transport technologies. The purpose of this activity is to provide guidelines for the evolution of the local exchange networks and meet the threat of competitive bypass. New features were designed and implemented in the Local Switch Replacement Planning System to support the BOCs in their post-divestiture needs.

VII-C SPC NETWORK PLANNING

Forward-looking work was done on the Stored Program Controlled (SPC) Network and its capabilities to support new service offerings. Example areas were: signaling network architecture planning and investigations of new data services including Fast Packet Networks; switching capabilities required for Integrated Services Digital Network; and use of automatic speech recognition in operator systems automation.

Planning was completed for the divestiture-related changes in the common channel signaling network and requirements were defined for the BOC interface to intercity carriers. Requirements were specified for operations methods and support systems. Work was continued to define functional signaling requirements for new services and to understand the interactions of existing signaling with new network technology, such as Touch-Tone or Multi-Frequency signals with echo cancelers.

Work on SPC network evolution considered the relationships between service feature offerings and the post-divestiture network structure. Computer-based systems used to plan SPC networks were enhanced to support evaluation and implementation of new services.

Methods were provided for AT&T and BOCs to plan their operator services networks after divestiture and the existing planning systems were examined for needed changes. Work continued on force management procedures, engineering rules for hardware provisioning and on formulation of overload control strategies.

VII-D NETWORK PERFORMANCE

Projects in network performance characterization focus on the relations between performance levels measured in the field and performance as perceived and expected by customers. These characterizations are used by engineers working on new services and by those responsible for network operations plans and performance objectives.

Work on methodologies for recommending performance objectives for network services and capabilities takes account of customer perception of key service parameters. Work was directed to both voice and data services with emphasis on the impact of new technologies, new services, and the specification of performance in the post-divestiture environment.

In 1983 preparations were in progress for a field survey to characterize transmission and signaling performance of loops and local special services in preparation for issuing Local Network Services Performance Specifications.

Network performance surveillance determines whether the network performance complies with specifications on the quality of service. The emphasis was on surveillance methods and equipment requirements for use by AT&T and BOCs in the post-divestiture multi-vendor telecommunications.

Analyses were continued to assess potential vulnerability of the telephone network to nuclear weapons effects, and to recommend plans to reduce such vulnerability. New technologies were reviewed which might be used to provide more robust emergency communications.

VIII AT&T INFORMATION SYSTEMS

The R&D program at AT&T Information Systems is similar to the program at Bell Laboratories except that it is smaller and does not include a major effort on basic research. Expenditures for qualified research activity were primarily for design and development of telecommunications and computer equipment and related software. There were 163 separately identifiable projects which qualified for the R&E Tax Credit during the 1983 tax year.

The various projects include qualified activities such as

- design and development of hardware and operational software for cellular portable telephone units,
- development and prototype fabrication of hybrid integrated circuits and printed wiring boards,
- research on new technology including satellites and private line microwave systems,
- significant enhancements of products and the development of new components used in telecommunications,
- engineering activities to advance the development of the electronic blackboard,
- creation of innovative software designed for a shared user-programmable data network which provides distributed communications and distributed data processing, and
- development of a significantly improved telephone tracking system which will handle call records for routing and duration.

IX AT&T TECHNOLOGIES, INC.

The majority of the R&D expenses incurred by AT&T Technologies, other than those activities performed for it by Bell Laboratories, was incurred in the development of manufacturing processes for telecommunications equipment, computers, electronic devices, cables, and optical fibers.

Chairman RANGEL. Our next panel, we have James Mungovan, a tax partner with Deloitte, Haskins & Sells; Martin Knestrick, with Commtech International; Larry Schoenberg, from the Association of Data Processing Service Organizations; and Professor Mahapatra from the California State University. We welcome all of you taking time out to share your views with us. We want you to know that your full testimony will appear in the record. We ask that you could cooperate with us and follow the 5-minute rule.

Mr. Mungovan.

STATEMENT OF JAMES D. MUNGOVAN, TAX PARTNER, DELOITTE HASKINS & SELLS

Mr. MUNGOVAN. Thank you, Mr. Chairman. I am pleased to be here and will restrict my comments to the benefits of the credit on small and medium-sized companies. Most small companies have a limited source of funds available for research. The benefits received from the credit are in many instances a critical source of funding for additional research. A few examples may illustrate how our clients make effective use of the credit.

The most typical example is of companies that are currently producing profit-generating products and paying taxes. To remain profitable, these companies must undertake additional research, but they are oftentimes unable to obtain bank borrowings for the development.

We would demonstrate to them that in planning the size and scope of near and long-term development projects, each incremental dollar spent entitles them to both the tax credit and the deduction.

The companies can therefore budget larger and more sophisticated R&D programs knowing that the U.S. Government is subsidizing a portion of the expenditures.

A second category of companies are those that are not yet profitable and must seek investors to fund development projects. To entice potential investors into investing, we instruct them that when the company becomes profitable, a portion of the income taxes payable on those earnings may be sheltered. This would be because of the carryover of the credits from earlier years. This reduces some of the additional funding that might otherwise be needed in the future from those investors and may also allow the founders to retain a larger percentage of their businesses.

Having illustrated some of the ways in which the credit does encourage new development, we wish to point out four provisions in the current law which should be changed to enhance its effectiveness. All are addressed in my written testimony and I will cover a few here.

First is the availability of the credit to start up companies. Second, the definition of research and experimentation for the credit should be clarified. Third is the incremental expenditure rule, and finally the credit should be made permanent. Currently, the credit is only available for expenditures incurred in carrying on a trade or business. Consequently, startup companies that are not actively producing and selling products cannot respond to the stimulus of the credit.

Yet many important technological advancements are made by these fledgling companies. The law should be changed so that the credit is available to a company when research is conducted in connection with a trade or business thereby extending the benefits of the credits to the new businesses. Of course, the effect of the credit may be delayed because startup companies do not immediately generate taxable income against which to apply the credit.

A number of the proposals including H.R. 4475 have provided that startup corporations be eligible for the credit, but these proposals would have excluded personal holding companies. Unfortunately, many startup corporations meet the definitional requirements of the personal holding company rules. This is due to their limited number of shareholders, and their only source of income being passive earnings on the invested capital. It is imperative that any legislation include a provision to allow these temporary and inadvertent personal holding companies to be eligible for the credit.

A technical problem with the incremental expenditure rule should also be addressed. In certain instances, only a portion of the current year's incremental expenditures receives full benefit of the credit, because the credit is limited to 25 percent of 50 percent of the current year's expenditures.

Nevertheless, all those expenditures are included in the base period when calculating subsequent years' credits.

Startup companies which are currently ineligible for any of the credit must also include these early years' expenditures in the base periods for subsequent year calculations. In some instances this will prevent those companies from ever recognizing the benefit of the credit. To eliminate the penalty against small companies, prior year expenditures which are ineligible for the credit should be excluded in subsequent years' base period computations.

Deloitte Haskins & Sells strongly supports the R&D tax credit as a means of encouraging technological progress in all industries. As we noted, the credit requires modification. By making certain changes, it should substantially enhance the environment for productive R&D activities. Thank you.

Chairman **Rangel**. Thank you.

[The prepared statement follows:]

STATEMENT OF JAMES D. MUNGOVAN, TAX PARTNER, DELOITTE HASKINS & SELLS

I am James D. Mungovan, a partner in the Boston office of Deloitte Haskins & Sells. I am the firm's lead specialist in research and development, and I welcome this opportunity to present to this Subcommittee testimony on the Research and Experimentation Tax Credit.

Deloitte Haskins & Sells is an international accounting firm which provides business and accounting services to companies of all sizes, including over 600 U.S.-based high technology companies. We believe that the Research and Experimentation Tax Credit is a substantial assistance to the continued viability of all our clients. Today, I will restrict my comments to the benefits and problems encountered by many of our small and medium sized clients.

The purpose of the 1981 legislation was to create a domestic atmosphere which would encourage technological advancements and assist in preserving our international industrial competitive edge. Many of these new and innovative developments are made by small and medium sized companies. It is essential that these companies continue to receive the financial resources that are currently provided by the credit and that some of the uncertainties that exist in the current law be clarified.

Most small companies have a limited source of funds available for research expenditures. Unlike larger companies, they generally do not have the ability to obtain conventional financing to perform research and experimentation. Thus, the benefits received from the credit are in many instances a critical source of funding for additional research. A few examples may illustrate how our clients make effective use of the credit.

The most typical example is of companies that are currently producing profit-generating products and paying taxes. To remain profitable these companies must undertake additional research but they are unable to obtain bank borrowings for the development. We would demonstrate to them that in planning the size and scope of near and long-term development projects, each incremental dollar spent entitles them to both the tax deduction and the credit. The companies can therefore budget larger and more sophisticated R&D programs knowing that the U.S. Government is subsidizing a portion of the expenditure.

A second category of companies is those that are not yet profitable and must seek investors to fund development projects. To entice potential investors into investing, we instruct them that when the company becomes profitable a portion of the income taxes payable on these earnings may be sheltered by the carryover of credits from earlier years. This reduces some of the additional funding that might otherwise be needed in the future from those investors, and may allow the founders to retain a larger percentage of the business.

The final example which we frequently encounter is in fields such as genetic engineering and biochemistry. Unlike many other new businesses, those companies require substantial funds for the establishment of laboratories. To finance some of these costs, the companies, in addition to their own research, will perform contract research for other companies. We instruct our clients that if the agreements are properly structured, the funding company is eligible for the credit. Since the funding company expends less on an after-tax basis due to the benefit of the credit, our client can frequently raise more funds from the contract research.

Having illustrated some of the ways which the credit does encourage new development, we wish to address four provisions in the current law which should be changed to enhance its effectiveness. First is the availability of the credit to start-up companies. Second is the definition of research and experimentation for the credit. Third is the incremental expenditure rules, and finally, the 1985 sunset provision in the present law.

Currently, the credit is only available for expenditures incurred "in carrying on" a trade or business. Consequently, start-up companies that are not actively producing and selling products cannot respond to the stimulus of the credit. Yet many important technological advancements are made by these fledgling companies. The law should be changed so that the credit is available to a company when research is conducted "in connection with" a trade or business, thereby extending the benefits of the credit to new businesses. Of course, the effect of the credit may be delayed because start-up companies do not immediately generate taxable income against which to apply the credit. Nevertheless, the importance of such firms in the technological process justifies their access to the credit.

A number of proposals including H.R. 4475 have provided that a start-up corporation be eligible for the credit. But these proposals would exclude personal holding companies. Unfortunately, many start-up corporations meet the definitional requirements of the personal holding company rules. This is due to their limited number of shareholders and their only source of income being passive earnings on invested capital. It is imperative that any legislation include a provision to allow these temporary and inadvertent personal holding companies to be eligible for the credit.

The definition of qualified research expenses which are eligible for the credit should be improved. We now recognize that, although adequate for deduction purposes, the definition of R&E in IRC Section 174 is not workable for purposes of the credit. A separate definition should be established solely for expenditures that are eligible for the credit. This would eliminate many of the problems our clients encounter in determining whether certain expenditures qualify. Specifically, this would be beneficial in the computer software field, The January 1983 proposed Treasury regulations on the IRC Section 174 would deny the credit to most software-related research. We believe that the proposed regulations improperly discriminate against this important dimension of the high technology sector and are contrary to Congressional intent.

One technical problem with the incremental expenditure rule should also be addressed. In certain instances only a portion of the current year's incremental expenditures receives full benefit of the credit because the credit is limited to twenty-five percent of fifty percent of the current year's expenditures. Nevertheless, all those expenditures are included in the base period when calculating subsequent years' credits. Start-up companies which are currently ineligible for any of the credit must include these early years' expenditures in the base periods for subsequent years' calculations. In some instances, this will prevent those companies from ever recognizing the benefit of the credit. To eliminate the penalty against small companies, prior year expenditures that are ineligible for credit should be excluded in subsequent years' base period computations.

The permanency of the credit is important both as a sign of the government's long run commitment to the support of research and development, and as a determinant in the firm's decision as to the size and timing of an R&D project. Without reasonable certainty that the credit will be available in the future years, a firm cannot be expected to factor the effective cost reduction offered by the credit into its R&D decisions. Consequently, the credit cannot have the full stimulative effect intended by Congress. In its current state, the credit discriminates in favor of shorter R&D undertakings at the expense of longer run projects—those more likely to yield the revolutionary advancements.

Deloitte Haskins & Sells strongly supports the R&D tax credit as an effective means of encouraging technological progress in all industries. Yet, as we noted, the credit requires modification. By making certain changes, it should substantially enhance the environment for productive research activities.

Chairman RANGEL. Mr. Knestrick of Commtech International.

STATEMENT OF MARTIN KNESTRICK, PARTNER, COMMTECH INTERNATIONAL

Mr. KNESTRICK. Good morning, Mr. Chairman. I find myself blessed and to some degree burdened by being late on your agenda this week. You have heard from many well-informed and thoughtful witnesses on the subject of the R&D tax credit. Being an entrepreneur myself and with your permission I will do what an entrepreneur does in a situation like this, which is to make best use of the situation. Rather than read my prepared statement, I will try to highlight some of the issues which are being obscured in this debate, and perhaps save the valuable time of you and the other members of the committee.

Chairman RANGEL. Your full statement will appear in the record.

Mr. KNESTRICK. Thank you.

You have heard a lot of testimony directed to the issue that we in the United States have to widely diffuse technology across our industrial base to improve the productivity of this country. We know the United States is competing in a very dynamic way internationally every day. You have also heard some perhaps surprising testimony that many of our high technology sectors are not faring well in their international markets today. You have heard that the United States expects to run a balance of payments deficit in the electronics industry, which is one of the major driving forces in this country toward change and growth.

You have heard that tax policy certainly does affect the actual incremental decisions made at the level of R&D spending. You have also heard that high technology firms in effect pay a higher rate of taxes than the average firm in this country.

We all know and share your concerns for the definitions of R&D expenses as the provisions of the credit are now written, and the uncertainty that you are now facing as to whether the credit has really had the kind of impact that you intended when you originally passed this legislation. I believe you will find that some of the data that will be coming particularly from the companies who were represented on the previous panel, will support the statement that on balance the weight of evidence will fall in the direction of confirming that the R&D credit, in fact, contributed to a considerable amount of incremental R&D being performed in the United States.

From the perspective of the Congress, it is fair and appropriate to look at the R&D credit as a test. There seems to be general agreement as to what that test has cost us, that being something in the range of $1.5 billion in lost tax revenues annually over the 1983-1984-1985 period. There are however two schools of thought today as to whether the test has been as valuable as it was intended to be. You have heard some say it is a windfall to companies who would have performed the same amount of R&D anyway, and you have heard others say that their decisions have been substantially impacted by the availability of the R&D credit.

The debate over that subject, however, obscures another point which I think is equally important. That is, to the extent you view the credit as a test, I would argue that that test was really not made available to a particular class of firms and people in this country who could probably use it the most. That segment is the entrepreneurial end of our economy: engineers, entrepreneurs, and investors who are willing to take on what is a very risky and long-term process of doing R&D for the purpose of building companies and manufacturing products.

There is considerable data around that suggests that the formation and growth of these small companies in fact creates more jobs in our country than many of the more established sectors of the economy. I believe you will find it quite consistent with the intent of the Congress that the credit be truly available as an incentive to organizations at this entrepreneurial end of the spectrum. I am not here to argue for an extension of the credit because I believe its extension is the minimum required. I am here to argue that the provisions of the credit be genuinely made available to those for whom in its present form the R&D credit is of relatively little value. Those are early stage operating companies and organizations who pursue R&D in a partnership form as a means of attracting private capital to this process.

I believe I understand the legislative history of the dialog which led to the credit. I understand the concerns which led to it being implemented in a manner so as to preclude its use by those doing R&D in partnership form. The reason for that, of course, is the concern that the provisions of the credit would be used to create yet another leveraged tax shelter investment vehicle in this country. We don't need another such vehicle. However, in the course of protecting against such abuse, Congress has made the credit generally unusable by a variety of entrepreneurial firms who could use it in a very legitimate manner.

I argue that, if use of the credit were extended to those kinds of organizations, its abuses can in fact be controlled. In the interests of time I will not enter some of the data that I might have used to support this thesis.

In conclusion, let me say that the issues which surround this discussion are so vital and so fundamental to the long-term economic interests of the country, I think we have to consider the question of burden of proof. You on the committee are certainly having to face the uncertainty that the data is not yet complete and it is not yet totally convincing as to the impact of the credit. However, I maintain that on an issue so fundamental that the burden of proof should rest on those who doubt its impact and not on those who believe it is having the effect that they have claimed.

In closing, I am going to reiterate something that the gentleman from IBM said earlier. There appears to be a tendency on the committee to view the credit as an expense of the Government. It is, of course, an expense in terms of lost Treasury revenues. However, I believe the debate that you are going to have would more properly be held in the context of viewing the credit not as an expense but as an investment. Those people in industry who are making the incremental R&D investment decisions view it as an investment.

The gentleman from IBM very eloquently stated the effective impact of those investment decisions. For $1 of additional R&D which would benefit from 25 cents in tax credit, IBM expects to pay the Treasury back five times that amount. And in addition, there will be additional revenues to the Treasury based on the taxation of the individual employees who are hired to perform that R&D. If the credit is viewed by the Congress as an investment rather than as an expense I believe you will find it to be in fact a very profitable investment in generating additional Treasury revenues.

I thank you for the opportunity to speak, Mr. Chairman. I would be happy to elaborate as you feel appropriate.

[The prepared statement and supplement follow:]

STATEMENT OF MARTIN KNESTRICK, PARTNER, COMMTECH INTERNATIONAL

1. Good morning, ladies and gentlemen. I appreciate the opportunity to speak to you today, and to add to your deliberations several thoughts regarding the research and development tax credit. My name is Martin Knestrick, and I am a partner with a firm known as Commtech International. I don't wish to burden you with a detailed explanation of our business, but it would perhaps be of value to you to understand the firm which I represent as it relates to our perspective on this issue and perhaps to our biases. The charter of Commtech is to develop and commercialize proprietary technologies which originate from SIR International, an organization perhaps better known to you by its former name, the Stanford Research Institute, and an entity generally regarded as a significant world-class research and development institution.

2. I come to you, therefore, not as a tax practitioner, but as one who represents a group which deals at the microscopic level with many of the same issues which will impact your debate regarding the value of the R&D tax credit from a macroscopic perspective. My comments will be directed not at the specifics of code sections or implementing regulations, but rather at the issue themselves.

3. Our role in life gives us perhaps a unique perspective on the subject; this perspective derived from several factors:

(a) First, we are in the middle of the high-technology arena, and therefore we see many of the problems which relate to effectively developing one of America's most precious resources, its technology base.

(b) Second, we now work with one large institutional source of new technology in the form of SRI International. In addition, we are in active conversation and contact with a variety of other large institutional sources of technology, primarily universities and to a lesser extent certain industry dedicated research facilities. I speak therefore, not only on behalf of our experience, but on behalf of other institutions which are seeking their own methods to convert more of this country's investment in research into practical products for our economy.

(c) And finally, in order to commercialize technologies once developed, we work with a wide variety of companies, both large and small, foreign and domestic. We see first hand the differing attitudes toward technological risk held by companies in this country and our competitors overseas. The differences are, in most cases, quite striking.

My comments should therefore be taken as representing a group which is truly on the front line in dealing with these issues on a daily basis. I hope you will find these comments helpful and informative.

4. By way of overview, I assume I need not elaborate upon the fact that what is at stake in this discussion is a fundamental issue, that being the competitiveness of the U.S. economy in the world economic system. There is a great deal of data which clearly indicates that in many important industrial sectors and markets, the United States is losing its historical advantage in implementing new technologies. There seems to be general agreement that the continued development of American technology is critical to our remaining competitive in the international economy over the decades to come.

5. The purpose of the Congress in creating the provisions of the R&D credit was, of course, to provide incentives to firms to take the very substantial risks incurred in doing the research necessary to develop new technologies and new products. Each nation, of course, has its own particular mechanisms for developing and implementing new technologies. Many of these approaches involve significant governmental involvement in the process. America's unique approach to encourage the continued development of its new technologies is not direct government intervention, but rather in creating the environment where this development can take place in a reasonable and efficient manner by the private sector. This process has worked in the past. Most believe it can and will continue to work in the future.

6. I am not here to argue for the minimum case that the research and development credit should be extended and made permanent. The need to do so seems rather obvious to someone in my place. I have come to this Committee in response to Chairman Rangel's stated hope, and I quote, "that other witnesses will address issues beyond whether the existing credit ought to be extended".

7. From the perspective of the Congress, it is perhaps appropriate to view the R&D credit as a test. There seems to be general agreement that the cost of this test is a revenue loss approximately $2 billion per year during the tax years 1983 and 1984. There are, however, two schools of thought as to whether or not the credit has had the intended effect of stimulating additional research and development expenditures. Some believe the credit has been but a windfall to large companies who would have done the same amount of R&D in any case. Some even make the case that in large part the long-term R&D spending plans for many of the larger organizations that have most benefitted from the credit were, in fact, in place before the credit was made available beginning in 1981. There are those at the other extreme who argue that the credit has indeed been very beneficial to increasing the gross level of R&D expenditures in this country. They argue that at a minimum the availability of the credit kept the level of R&D expenditures from declining during the recessionary period of 1981 and 1982.

8. Debate over this subject, however, obscures what I believe is an even more important issue. To the extent that the credit can legitimately be viewed as a test case, I would argue that the test was not really applicable to that segment of American industry which perhaps could produce far greater additional value to the economy and most likely could do so at considerably less cost to the Treasury. That segment is the entrepreneurial end of the American economy, those engineers, entrepreneurs and investors who are willing to accept the high risks of building new companies by developing new technologies. Again there is considerable data which suggests that the formation and growth of new and small companies has, in fact, created more new jobs in this country than have the more established sectors of the economy. There is also a great deal of data which indicates that the implementation throughout our economy of emerging technologies has generated a greatly disproportionate share of the growth in our gross national product, in creating new jobs, and in generating a balance of payments surplus in our international trading accounts. It would seem, therefore, quite consistent with the intent of the Congress that the credit be truly available as an incentive to organizations at the entrepreneurial end of the spectrum to develop and commercialize new technologies.

9. I am here to argue not only for an extension of the credit as it now exists. I am here to argue that the provisions of the credit be genuinely available to those for whom, in its present form, the credit is generally of little value. These are early stage operating companies and those organizations who pursue research and development in a partnership form as a means of attracting private capital to this process.

10. I understand the Legislative history of the dialog which led to the creation of the credit, and understand the concerns which led to its being implemented in a manner such as to exclude the use of the credit by organizations pursuing research and development in partnership form. Understandably there is great cause for con-

cern that the credit could be misused and abused by those who might seek to syndicate the benefits derived, and in so doing create yet another leveraged tax shelter investment vehicle. However, in the process of protecting from this abuse, the Congress has precluded the bona fide use of the credit by those organizations legitimately pursuing research and development by use in some manner of the R&D partnership vehicle.

11. I would argue that the abuse can in fact be controlled by the provisions for implementing the credit. If it were available to those pursuing research and development in partnership form only on the basis of actual hard cash invested, and were available only for those expenses which otherwise qualify as research and development, I believe you would find it possible to remove the incentive for abuse of the credit in creating tax avoidance schemes. If the credit were available only on this hard dollar basis, such that additional leverage in a variety of forms would not further enhance its value, I believe that the economic incentive would be reduced to zero for those whose intentions are not to create value but to reduce the tax obligation of certain taxpayers.

12. Let me divert for a minute, if I may, and tell you a personal story. In principle, our organization carries out its charter by combining potentially valuable technology from an institutional source with an entrepreneural management group and private sector financing to continue and complete the development of those promising technologies. In seeking to raise money from the private sector, we of course compete with a variety of investment alternatives, most notably real estate partnerships. These types of investments are the beneficiary of several incentives available under the provisions of the Tax Code. From that prospective, I would argue that in the course of raising private sector financing for the pursuit of technology development, we and others like us are at a rather considerable disadvantage to other types of investment vehicles which themselves are structured to take advantage of the incentives in the Code for their purpose. I can assure you that raising private sector funds for our work is a formidable challenge indeed.

13. My comments and suggestions can be summarized as follows:

a. There is no question in my mind that the credit should be extended, and in fact be made permanent as it now applies to established manufacturing companies.

b. The credit should be made available to entrepreneural entities other than those established companies, these entities being start up corporations and those pursuing research and development in partnership form.

c. If extended to include R&D which is performed by means of a partnership, the potential for abuse of these incentives to create tax driven investments can realistically be controlled.

14. In conclusion, I would like to comment on the context in which the decision regarding the R&D tax credit must be made. It is vital to both short term and long term U.S. economic interests to incentivize the development of the next waves of technology. Failure to create and implement across a wide spectrum of our industrial base the substantial benefits of new technology would have a disastrous consequence to our economy. I argue forcefully that the incentives available from the R&D tax credit have in fact not been available where they could do the most good. And I would suggest, that since the issues involved in the continued development of new technology are so vital and so fundamental that the burden of proof as to the value of the credit should be on those who doubt its impact rather than on those who believe it can be of considerable value in providing incentive to engineers, entrepreneurs and investors in taking the considerable risks involved in pursuing R&D.

I thank you for the opportunity to speak, and would be happy to elaborate on any of the points I have made in this statement.

SUPPLEMENTAL QUESTIONS PROPOSED BY MR. RANGEL

Question. Whether your firm and/or association members claimed the research tax credit.

Answer. No. The credit is not available to firms like ours which attract private sector capital to technology development.

Question. If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

Answer. Our firm agrees with the tightening of definitions of qualified R&D, particularly in the context of extending availability of the credit to start up organizations and R&D partnerships, with provision, to restrict abusive use.

Chairman RANGEL. Thank you, we will now hear Mr. Larry Schoenberg.

STATEMENT OF LAWRENCE J. SCHOENBERG, CHAIRMAN, AGS COMPUTERS, INC., REPRESENTING ASSOCIATION OF DATA PROCESSING SERVICE ORGANIZATIONS, INC.

Mr. SCHOENBERG. Mr. Chairman, I am Lawrence J. Schoenberg, chairman and chief executive officer of AGS Computers and I would like to thank you for inviting me to testify and ask that my written statement be made part of the record of this hearing.

Chairman RANGEL. Without objection.

Mr. SCHOENBERG. AGS Computers provides software development services, builds and markets software products, and distributes microcomputers with the related peripherals and software packages. AGS is America's largest custom software company serving the commercial market. I am proud to say that AGS was recently selected by Inc. Magazine as one of this Nation's 100 fastest growing companies, and just this week was named the No. 1 distributor of microcomputers by Computer Retail News.

I appear before you today not only on behalf of AGS Computers, Inc., but also as a representative and former chairman of the Association of Data Processing Service Organizations [ADAPSO], the trade association of this Nation's computer software and services industry. ADAPSO's 700 corporate members are involved in a tremendous amount of innovative research and development. ADAPSO members are at the forefront of the software technology that has moved the United States well into the information age.

ADAPSO urges continuation of the tax credit and assurance not only that software be covered under any new definition of qualified research, but also that past expenditures for software development be declared eligible for credits already claimed.

The R&D tax credit has sparked a wave of new computer products and services. Since the enactment of the credit the number of software products on the market has increased dramatically. Between 1982 and 1983, there was a 61-percent increase in the overall number of available software products, from approximately 21,000 to over 34,000.

Many ADAPSO members believe the R&D tax credit does provide an incentive for the development of new and better products. For many, it is the difference between producing and not producing a quality program. In fact, only a very small percentage of ADAPSO members recently surveyed said that while they claimed the tax credit, it had no discernible impact on the time and money they spent on research and development.

ADAPSO members did find, however, that auditors generally insisted in 1983 that R&D tax credits be accounted for as deferred taxes. Some software companies were consequently faced with sharply increased tax rates. The auditors made this request because of the confusing proposed regulations issued by the IRS back in January 1983.

Therefore, the R&D tax credit should be retained, and it should be made a permanent part of the Internal Revenue Code. The R&D tax credit should be made permanent rather than merely extended, because the research and development programs of most companies are planned well in advance and often developed over multiyear periods.

If the credit is due to expire in the middle of a product's development cycle, a company may not embark on the new project at all. A permanent R&D tax credit will give those companies a continuing incentive to begin each new cycle of major research and development.

The R&D credit provisions should also be clarified to ensure that it does not deem intended beneficiaries ineligible. The present rules have been confusing and the IRS has found it impossible to write adequate interpretive regulations. A new definition of qualified research is in order. Software development should be treated like any other research and development. A change should also be made in the rules preventing startup companies and established businesses interested in starting a new product line or entering a new field from claiming the credit.

[The prepared statement follows:]

STATEMENT OF LAWRENCE J. SCHOENBERG, CHAIRMAN, AGS COMPUTERS, INC., MOUNTAINSIDE, NEW JERSEY, ON BEHALF OF THE ASSOCIATION OF DATA PROCESSING SERVICE ORGANIZATIONS, INC., (ADAPSO)

Mr. Chairman, Members of the Subcommittee, my name is Lawrence J. Schoenberg. I am Chairman of AGS Computers, Inc., 1139 Spruce Drive, Mountainside, New Jersey, 07092. I am pleased to be invited to testify on the Credit for Increasing Research Activity, Internal Revenue Code § 44F, the R&D Tax Credit.

AGS Computers, Inc., offers computerized solutions for America's largest telecommunications, finance and high technology corporations. We provide software development services, build and market software products and distribute microcomputers with the related peripherals and software packages. AGS is also America's largest custom software company serving the commercial market. We analyze customer information requirements, develop specifications and design and implement automation solutions. AGS designs, markets and supports proprietary software packages for use in banking as well as in planning and managing the development of data processing and research and development projects. The company is the market leader in project management software and its major bank packages are industry standards. AGS is the nation's largest distributor of microcomputers. The company selects the best price/performance products and distributes those hardware and software products to computer retailers and other companies who deliver specialized computer systems. I am proud to say that AGS was recently selected by Inc. Magazine as one of this nation's 100 fastest growing companies, and just this week was named the number one distributor by Computer Retail News.

I submit this statement not only on behalf of AGS Computers, Inc., but also as a representative of the Association of Data Processing Service Organizations, Inc., ("ADAPSO"). ADAPSO is the trade association of this nation's computer software and services industry. ADAPSO's 700 corporate members provide the public with a broad range of products and services including software for mainframe, mini and microcomputers, remote data processing, professional systems analysis, design and programming services, and integrated hardware/software systems. My company has been a member of ADAPSO for over 10 years, I have served as Chairman of the Association.

ADAPSO is extremely interested in these hearings and in the continued viability of tax credit, because its members are involved in a tremendous amount of innovative research and development. ADAPSO members are at the forefront of the software technology that is so vital to our national defense, space programs, and in the fields of nuclear power and medicine, and virtually every other aspect of American life. The work of ADAPSO members has moved the United States well into the Information Age. We have developed software and computer systems not only for the mightiest corporations, but also for small businesses, doctors, lawyers, farmers, homemakers — indeed, for the average American. We have expanded the productivity of people in all walks of life, and yet, we have not even scratched the surface of what we might accomplish with computer power.

The United States computer software industry currently leads the world in innovative software products and services. Our lead is in danger, however, as companies in Hong

Kong, Singapore, Taiwan, Japan, Korea, and others start to build their software industries with the encouragement and financial assistance of their governments. Software development is an expensive and time-consuming task that entails serious financial risk. Turning an idea into a completed software package or service at or under budget is no mean feat. Even if the development process is successful, the package may or may not find immediate acceptance in the marketplace. Incentives such as the R&D tax credit often give the necessary impetus for many companies to take the risks inherent in the process of developing the new products that keep the United States on the "cutting edge" of technology.

ADAPSO agrees with you, Mr. Chairman, that renewal of the R&D tax credit provisions should not wait until Section 44F is about to expire, at the end of 1985. We have an opportunity now to set the pace for the future. We can send a message to U. S. companies that incentives will continue so that they may strive to develop even more innovative products and services.

In this light, Mr. Chairman, the issues set forth in the Subcommittee's notice of this hearing afford us an excellent structure for reexamining the R&D tax credit. With your permission, I will address the remainder of my comments to these basic issues.

1. **The credit has stimulated additional research expenditures and has had a substantial, positive impact on industry spending and allocation of research expenditure budgets.**

   The credit has stimulated additional significant research expenditures and has had a substantial, positive impact on industry spending and allocation of research expenditure budgets. The United States computer software and services industry has grown tremendously over the past decade. Domestic sales of software and services reached $33.5 billion last year. INPUT, Seventeenth Annual Survey of the Computer Services Industry (1983). This was an increase of 22% over 1982 when industry revenues were $27.6 billion. Software products companies as a whole have realized annual revenue growth of 42% for 1981, 41% for 1982, and 39% for 1983. INPUT Survey. ADAPSO expects the computer software and services industry to grow over the next four years at an average rate of 22%. This vitality would not be possible, however, without positive incentives for new product development. The R&D tax credit significantly reduces the financial risk of undertaking a product development effort, thereby increasing a company's ability and willingness to undertake additional projects. Further, to the extent research and development would have been undertaken without the credit, the R&D tax credit lessens the cost, freeing funds to engage in even more R&D. The incentive for putting tax savings back into R&D is, of course, the credit itself.

In preparation for my testimony, ADAPSO conducted an informal telephone survey of a representative cross section of its members to determine what, if any, effect the credit for increasing research activity has had on their spending and allocation of research expenditure budgets. The results, not surprisingly, show that for many companies the R&D tax credit is very important. Often, it is the difference between producing and not producing a quality program:

- 20% percent of those surveyed said they spent more time to develop a better product because of the credit. For these companies 25% or more of their annual revenues are spent on research and development, and while they might have produced a software program anyway, the product would not have been as effective or efficient as it turned out to be.

- Another 20% agreed that they, too, would have produced a program absent the credit, but the credit provided an incentive to produce a top of the line product on a faster schedule.

- A third group of 20% estimated that it is normal for them to spend about $25,000 a year on R&D. Because of the credit, research and development expenditures by individual companies surveyed reached generally upwards of $200,000. Often a company in this group was able to develop a program it may not have attempted otherwise.

- A fourth group of about 20% did not claim the tax credit because of confusion in interpreting proposed implementing regulations. By and large, however, these companies responded that if they had taken the credit, it would have had a positive effect and resulted in their producing a better product.

- Finally, another 20% of these companies surveyed said that while they claimed the tax credit, it had no discernible impact on the time and money they spent on research and development.

Overwhelmingly then, the companies responding to ADAPSO's survey believe that the R&D tax credit does provide an incentive and has resulted in new and better products. This is certainly what the framers of the credit intended to achieve.

2. The R&D tax credit has sparked a wave of new computer products and services.

The R&D tax credit has sparked a wave of new computer products and services. Since enactment of the credit, the number of software products on the market has increased dramatically. The expansion can be attributed in large part to widespread availability of microcomputers and the growth in the microcomputer software industry. PC Telemart, a software directory, reported a 61% increase in the overall number of available software products, from approximately 21,000 to over 34,000 between 1982 and 1983. PC Telemart, Software Directory (8th Ed.), 1984. PC Telemart reports that "[t]he explosion in the number of software applications now running on microcomputers is indicative of the magnitude of the technological revolution around us." Interestingly, the most significant gain was witnessed in the field of educational software, where the number of products rose from 1,680 in 1981 to 10,540 in 1983.

The R&D tax credit has served as incentive not only for software products companies but also for remote processors, systems integrators, and processing services companies. Innovative software development in these fields has resulted in expanded networks allowing more individuals to have access to more information. Computer systems are now available to a wider market of businesses, and with greater availability, productivity and competitiveness are enhanced.

Industry analysts predict that during 1984 and 1985, the movement of innovative technologies to commercially available products and services will greatly accelerate. Remarks of William F. Zachman, Vice President, International Data Corporation, 1984 Industry Briefing Session (March 2, 1984). We are working continuously to improve the software that has resulted in tremendous advances in advanced robotics, computer aided design, integrated software, and artificial intelligence. Progress requires that change be the only constant. The R&D tax credit helps to ensure that the incentives for progress will remain high.

3. The tax credit provision should be made permanent.

The R&D tax credit should be made a permanent part of the Internal Revenue Code. The R&D tax credit should be made permanent rather than merely extended, because the research and development programs of most companies are not only planned well in advance but are also cyclical in nature. Certainly the major objective of the originators of the R&D credit was to generate increased research and development, but realistically, R&D for every company will not increase every year. The more likely course is for a company to experience a new thrust of research and development every few years. Different companies and products may have different cycles. If the credit is due to expire in the middle of a product's development cycle, a company may not embark on the new project at all. A permanent R&D tax credit will give those companies a continuing incentive to begin each new cycle of major research and development.

Another reason for making the R&D tax credit permanent is to give proper incentives to the many new, dynamic companies which are not presently eligible to claim the credit, but which are involved in some of the most innovative software development going on at present. These companies for the most part are small and in need of not only incentives to encourage them to begin but also credits to help them succeed. How unfortunate it would be if we lost a source of new, technologically advanced products and failed to help a fledgling company by letting the R&D tax credit expire.

The United States must not be complacent in the race to build new technological products. For the forseeable future we will be fighting to stay ahead, and perhaps in some cases even struggling to catch up with our foreign competitors. There will be no point at which it will be in our nation's best interest to stop encouraging research and development. The present R&D tax credit is not ideal, but it has been a successful experiment in spurring production of technologically innovative products and services. Tax incentives should not be viewed as a short term fix. Instead, as the expiration of the credit approaches, it is time to vote for continued progress by making the credit permanent.

4. The tax credit provisions would be more effective if Congress were to clarify and reaffirm that software and computer services research and development costs qualify for the R&D tax credit.

The tax credit provisions would be more effective if Congress were to clarify and reaffirm that software and computer services research and development costs qualify for the R&D tax credit. The computer software and services industry has labored under confusing and often conflicting signals over eligibility for the credit during the past three years. Twenty percent of those responding to ADAPSO's survey, for example, did not claim the credit even though they were involved in significant R&D, because of confusion over the language. When the credit was first enacted, the message from Congress was that in order to maintain our lead in the high technology race, we would have to create incentives to engage in major research and development ventures. The drafters of the Economic Recovery Act of 1981 recognized that the United States was in a state of near-crisis because of declining research and development. Assistant Secretary for Tax Policy John E. Chapoton reaffirmed in 1983 that, "Congress enacted the tax credit for incremental research and development expenditures in order to improve the competitiveness of the United States in the world economy by stimulating the research and development activities that will lead to productivity enhancing innovation." (See, May 27, 1983, Statement of Assistant Secretary Chapoton before the Subcommittee on Taxation and Debt Management of the Senate Committee on Finance, p. 2.) The United States computer software and services industry embraced Congress' efforts to bring about increased research and development.

Six months after the credit was enacted, and at a time companies had already begun to commit resources to increased research and development in reliance on the credit, the Internal Revenue Service issued proposed regulations that suddenly made it unclear whether a commitment by the computer software and services industry to increased R&D was justified or not. 48 Fed. Reg. 2790 (January 21, 1983). The Internal Revenue Service proposed that the credit be available only for the development of a "new or significantly improved" product, the operational feasibility of which was seriously in doubt from the onset. Prop. Reg. § 1.174-2(a)(3). In other words, if one were fairly certain the project would fail, then the IRS would consider extending a tax credit on what was spent. Compounding the problem further, the proposed regulations changed the eligibility requirements for Section 174, thus denying to most companies (except those with major failures) the benefits of both the tax credit and the longstanding Section 174 deduction election. The proposed regulations appeared to overturn Revenue Procedure 69-21, the mechanism by which software developers had deducted their R&D costs under Section 174. Rev. Proc. 69-21, 1969-2 C.B. 303.

ADAPSO and many others filed comments with the IRS pointing out the inherent problems with the proposed regulations. Statement of the Association of Data Processing Service Organizations, Inc., In the Matter of Proposed Amendments to the Income Tax Regulations to Provide Rules for the New Credit for Increasing Research Activity (March 25, 1983). I appeared at the public hearing in April 1983, and argued that while the United States computer software and services industry would certainly survive without the tax credit, a golden opportunity was being lost. My point was and still is that with other countries working hard to build up their software and services industries (often with governmental assistance), the United States will find it impossible to remain number one by discouraging domestic R&D. Other countries with significant tax incentives might become more attractive as companies consider where to conduct future R&D.

Why is it so important to ensure that the credit is available to developers of software and computer services? Software and computer services represent the future. Hardware is certainly an important part of the equation, but without software and services, the computer is just an empty box. Advances in hardware dictate that advances in software and services must not be allowed to decline. If anything, the need will be for more powerful and more sophisticated software. The so-called "fifth generation computers" now under development will not be able to run on any traditional software efficiently. The computer software and services industry will need to produce quality products on a fast track to allow society to reap the full benefits of improvement in the hardware.

5. The tax credit rules can be improved so as to have a more positive impact on increasing research and experimental expenditures if the "in carrying on" test were eliminated.

ADAPSO has no comment on the base period computation rules in this testimony; however, it has some serious concerns about the "in carrying on" test for the credit. Section 44F as presently written prevents start-up companies from claiming the credit. Start-up companies in the computer software and services industry are involved in the most innovative research and development but could undoubtedly be doing more if given the benefit of an incentive like the R&D credit. Most microcomputer software companies, for example, were not even in business a few short years ago. The same barrier exists for some established companies interested in expanding and diversifying their existing trade or business. The present rules preclude them from claiming the credit, which may have caused some to decide against some new innovative venture.

The problem can be solved through adoption of language similar to that found in Section 882 of the recent Deficit Reduction Act of 1984, language that was passed by the Senate, but unfortunately excluded from the final compromise tax package. S. 2165, 98th Cong., 2d Sess. § 882 (1984). The language of Section 882 provides that -

> [a]ll in-house research expenses and contract research expenses paid or incurred by a regular corporation shall constitute qualified research expenses if, at the time such research expenses are paid or incurred, the principal purpose of such corporation is to use the results of the research in the active conduct of a present or future trade or business and not to license or otherwise transfer such research results to any person other than a member of the same controlled group of corporations . . . ." (Emphasis added.)

With this language a new or existing company may claim the credit, while at the same time, tax shelters are clearly excluded from eligibility.

There is one slight problem with this language, however, and that is the definition of a "regular corporation". The term is defined in such a way that many of these same innovative start-up companies will continue to be excluded from eligibility. A regular corporation is defined as any corporation other than a Subchapter S, a personal holding company, or a "service organization." This definition is troublesome, because many start-up companies in the computer software and services industry organize as an S corporation or find themselves subject to personal holding company restrictions. A company may be classified as a personal holding company if it derives most of its income from royalties on copyrighted works. The personal holding company restrictions were not created with software companies in mind, but for many, by virtue of their restricted ownership and the fact that they license a copyrighted work, software, the rules may apply. The restriction on "service organizations" is also confusing. Reference is made to certain pension provisions in order to define the term, but some might argue that any company called a "service organization" would be excluded from the credit. I.R.C. S 414(m)(3). In the computer software and services industry a "service organization" is a company that utilizes computer technology by delivering people-support and software to provide information based solutions. This is the exact group that Congress intended to give the R&D tax credit incentive.

6. Both a tax credit and a tax deduction should be available for research and development expenditures.

A tax credit and a deduction election should be available for research and development expenditures. Both provisions were designed to stimulate research and development; however, the credit rewards entrepreneurs taking additional risks to develop new products. The tax credit creates an incentive to risk capital on R&D activities where the tax laws might otherwise weigh against such an investment. The deduction election, although no less important, was created to encourge companies to engage in research and development, and allows business generally to deduct cost which might not fit easily into traditional categories of business expenditures. The tax credit was created because Congress believed that even with the deduction election, investment in R&D was inadequate, and because an incentive was needed for increased R&D aimed at technologically innovative products. (See, H.R. Rep. No. 201, 97th Cong., 1st Sess. 114 (1981), and S. Rep. No. 144, 97th Cong., 1st Sess. 75 (1981).) The tax credit was designed to aid a narrow but very special class.

Even where a tax credit and a deduction election result from the same expenditures, this result is justified by the need for increased R&D. Many other countries like Japan and Great Britain provide tremendous tax advantages to their domestic software industries. These countries have targeted software as a major export product by the end of the century. Their strategy includes interconnection between financial institutions, government and industry which spreads the financial risk. Tax credits, deductions and lowered tax rates are all part of the picture. By comparison, the tax picture in the United States is not as bright. The ACRS, for example, provides little, if any benefit for high technology companies. Further, according to the IRS, investment tax credits may not be readily available for purchases of software. This is, in my opinion, not what was intended under the ITC provisions, but the IRS has indicated, for the time being at least, that separately priced software will be considered an intangible, and therefore not eligible for ITC. Rev. Rul. 71-177, 1971 C.B. 5. The R&D tax credit and the deduction election provide part of what little tax incentive there is for a company to become involved in this risky and capital intensive business.

7. **The impact of the tax credit provisions on federal revenues has been significant, but the credit should not be narrowed so as to limit investment in technologically innovative products and services.**

Comments by the Treasury Department and the Internal Revenue Service would indicate that total revenue loss resulting from the credit has exceeded estimates. The figures show that for the second half of 1981, R&D credit of $600 million was claimed. (See, May 27, 1983, Statement of Assistant Secretary Chapoton, at 3-4.) The disturbing point to Treasury, however, seems to be the number of industries claiming the credit. Only half of the credit went to companies in the "high tech" and traditional manufacturing fields, the group supposedly targeted in 1981. Interestingly, Treasury has expressed concern repeatedly about fast food restaurants and other "non-technical" companies claiming new product development eligible for the credit. It is up to Congress to decide how the R&D tax credit should be changed to eliminate those concerns. At the same time, however, care should be taken to preserve the credit for "high tech". There have been continued assurances from both Treasury and the IRS, however, that computer software is an area definitely intended to benefit under the credit. A tax credit aimed just at high technology may be expensive, but it would certainly be less expensive than a broader based credit, the investment in our future would be well worth the cost, and the return to the Treasury in terms of tax dollars generated by profits would be significant.

8. The tax credit should be continued but with certain statutory or administrative changes.

ADAPSO urges that the credit for increasing research expenditures should most certainly be continued, and agrees that statutory and administrative changes should be made not only in how the credit is interpreted for the future, but also in how past claims for the credit will be regarded. A new definition of qualified research is in order. The current definition should be amended such that software developed for license or to be used in connection with services provided to third parties would be eligible for the credit. Again, the language of unenacted Section 882 of the Deficit Reduction Act is a solid foundation for this change.

Section 882 and its definition of "qualified research" limits eligibility to those costs related to research aimed at or used in the development of a "technologically new or improved business component of the taxpayer." A "business component" is defined to include software, and "technological" is defined to include principles of computer science. ADAPSO believes that this is a major improvement in the language of the credit.

Not all software will qualify under this language; one of the exclusions involves "internal use" software. Proposed Section 882 generally precludes credit eligibility for software development costs where the software is separately developed by or for the benefit of the taxpayer, for the taxpayer's own internal use. Such internal-use software nevertheless may qualify for the credit where (1) it is used in other qualified research, (2) it is used in a production process that contains a component qualifying for the credit (*e.g.*, software for robotics assembly), or (3) it is technologically new or improved, surmounting a high innovation threshold (to be established by Treasury), and otherwise satisfies the general requirements set out in Section 882. ADAPSO urges Congress to send some clear direction to Treasury on this last point.

Under the language of Section 882, the kinds of software development costs intended to be excluded from credit eligibility are, generally speaking, those costs associated with software used *internally* for general, managerial and administrative functions (payroll, bookkeeping, personnel management, inventory control) as well as software used internally in providing "noncomputer services" (accounting, consulting or banking services).

These last provisions may have an inadvertent effect the Subcommittee should be careful to avoid. These provisions are intended to exclude directly only that software used internally by the *taxpayer* for its *own* managerial or administrative functions or to facilitate the *taxpayer's* provision of *personal* or *professional* services. These last provisions are not intended to exclude software development costs *per se* where the software is offered by the taxpayer as a product to third parties, where the software is developed by the taxpayer for resale (by any means) to the general public without significant case-by-case modifications or where the software is for the taxpayer's provision of computer-based services to customers (*See*, May 27, 1983, Statement of Assistant Secretary Chapoton, at 6-7; February 24, 1984, Statement at 5-12.)

As the Subcommittee considers changes in Section 44F, ADAPSO urges caution to ensure that the above stated intention regarding provision of computer-based services to others is carried through. Credit eligibility should remain for all software offered commercially to third parties so long as the development costs meet the overall requirements of the section.

I have one final important note. Certain administrative changes are necessary to protect companies that have claimed the credit for qualified R&D over the past three years in reliance on statements of Assistant Secretary Chapoton and the stated intent of Congress to foster innovated R&D. These companies have made a best efforts attempt to calculate their qualified expenditures while laboring under confusing proposed regulations and a long period of silence from the IRS. If any changes are made in the definition of qualified research, they should be made retroactive only in the most unusual circumstances, and if anything, ambiguities should be resolved in favor of the taxpayer.

In conclusion, Mr. Chairman and Members of the Subcommittee, I would like to thank you for inviting me to testify on the issue of the credit for increasing research activity. ADAPSO looks forward to working with you on a fair and equitable extension of this important tax provision. Thank you.

Chairman **Rangel**. We thank you for your contribution.

We will hear now from Professor Mahapatra.

STATEMENT OF S. MAHAPATRA, PROFESSOR, DEPARTMENT OF ACCOUNTANCY, SCHOOL OF BUSINESS ADMINISTRATION, CALIFORNIA STATE UNIVERSITY, LONG BEACH

Mr. **Mahapatra**. There is a slight printing mistake there. I am professor at Long Beach and not Los Angeles.

Chairman **Rangel**. Very good. Thank you for correcting that.

Mr. **Mahapatra**. I am not here representing any group as such. It just so happened I was researching this back in 1982 when I was at Syracuse. We get worried sometimes about whether legislators do in fact do what they say they ought to do. So I wanted to study if accounting for R&D—whether various ways do create problems.

So I started looking for what studies have been done and I discovered that about 10 years ago there was a very well-funded NSF study done by two faculty members from Carnegie Melon who had assumed indeed there was a positive correlation between R&D policies and technological innovations except they could not come across any empirical data that you have been looking for today.

So I started around looking for doing some study which would provide some empirical data. I discovered that Canada had probably the very best and most liberal tax credit program for R&D almost for 10 years; from 1967 through 1976. So I set out to study their data to see what was the real effect as opposed to what ought to be the effects.

And the answers are not going to please many of you and going to thoroughly please some of you. The answers were that, yes, there was an increased R&D there over that 10-year period, but the amount of increase was not really significant, and probably quite close to the amount of credit itself and no more than that.

However what they went through is much more important actually. There was a switch in the kind of research that they wanted to do. So they started doing research which they would complete in 6, 7, 8, 10 years instead of 3 or 4. On the average, all the companies that in fact took advantage of the Tax Act increased their long-range high tech kind of research which really contributed a lot more than the simple increase in R&D.

So that is what really was the positive benefit of that. Then of course the Canadians decided to disband it so that what research had been done and the technology has come out to give time to industry to benefit commercially, by commercially marketing other than going at it and doing more research.

So that is really the empirical data that I have been able to find that I can share with you because as you have been mentioning, the academicians have been telling you that there is no relation. And so I went out to gather the data in a systematic way to see if there was any. I have given about a 34- or 40-page paper to all of you.

If you look at the tables that summarize all the data, what is more interesting I found is that it is the young companies, 0 to 5 years, were much more innovative and successful than companies which are rather old like 20 years or more and so that led me to conclude that maybe we should have some kind of policy whereby the startup companies who do not have enough tax base or profit base to absorb all the tax credit ought to get maybe a longer period.

But there is no evidence I can present to say we ought to make it permanent. I cannot present evidence. My best recommendation would be maybe we ought to make it about 10 years or maybe 8 years, two Presidential terms, before we reevaluate it and make anything permanent. That would be sort of based on the data I have been able to collect on the study I have done for the Canadian industries where they have similar kinds of tax benefits for about 10 years.

That would be my presentation here. Some of the other questions you have been asking I can answer some of those. You have been asking the question as to should we make this R&D for the fast food and for the fashion industry? The answer is, yes. What is wrong in being the capital of the fashion industry, Paris is the capital. What is wrong with Los Angeles being the capital of that?

There is more money to be made in fast food by selling it to Chinese than selling a few computers, too. I was surprised, one day, a very famous partner of Arthur Anderson & Co., with my friends from Haskins & Sells who know Leonard Podgett who used to be private counsel to Mr. Kennedy.

He was telling me one day, he said, "Do you want to spend your time in academia?" I said, "yes". He said, "Why don't you go into business?" I said, "what business?" He said, "There is a lot of money to be made in toilet seats because nobody is doing anything there so there is money in the mundane things."

We can't always go for the glamour. So there is nothing wrong with giving equal treatment to fast food and fashion indusry as well as IBM.

Chairman RANGEL. How do you measure, Professor, where this type of expenditure is productive? From looking at the size of the hamburger?

Mr. MAHAPATRA. No, the cost of the hamburger, the taste of the burger, the service rate of the hamburger. For example, I come from India. I suppose you sometimes go and see, you stand in the food line there, you be waiting for 3 hours to get your food. By that time you would be gone where as in the United States, you don't have to do that. There is some—yes, I understand your question.

But at the same time it is not really that clear cut to say that, yes, we have not made any progress. The answer is, no.

Chairman RANGEL. Thank you for your contribution. This has been a very distinguished panel. Our record will remain open until September 17 in case there is additional information that you would like to bring to our attention. Thank you very much.

Mr. MAHAPATRA. Thank you.

[Mr. Mahapatra submitted the following:]

THE INDUSTRIAL RESEARCH AND DEVELOPMENT INCENTIVES ACT (IRDIA) OF CANADA AN EMPIRICAL STUDY

(By S. Mahapatra, Department of Accountancy, California State University, Long Beach, California)

Introduction

The objective of this study is to empirically investigate the effects of governmental incentives to promote research and development activities of private enterprises. "In general, one can safely say that there has been almost no evaluation of the effectiveness of governmental policies for stimulating R. & D." (Kaplan, et. al., 1976, Executive Summary, p. 2). The Industrial Research and Development Incentives Act (IRDIA) of Canada was an incentive program for R. & D. This study specifically investigates the effects of IRDIA on the research and development (R. & D.) activities of Canadian private enterprises. The Canadian program was chosen because during the IRDIA years (1967-1976) Canada had one of the most generous set of tax incentives and government grants for R. & D. work. The IRDIA of 1967 provided extensive financial support for firms developing and maintaining R. & D. facilities (Kaplan, et. al., 1976, Chapter 1, p. 34). The analysis of the IRDIA program should be quite beneficial here, in that the Canadian economy has a close resemblence to the American economy and Canada is the largest trading partner of the U. S. A. The study would have direct implications for the effectiveness of a similar program under the Economics Recovery Tax Act of 1981. Congress will be considering soon whether to extend the tax credit for R. & D. (part of ERTA, 1981) which expires next year.

Rationale for the Study

The case for and against governmental incentives (intervention) for R. & D. activities is well argued in the literature. The case for governmental intervention is that the social rate of return from R. & D.

is higher than the private rate of return; if left solely to private initiative and investment, there will be an underallocation of resources to innovative activities (Baty, 1964; Grossfield and Heath, 1966; Horowitz, 1962; Morrisey, 1971). The disparity between social and private returns to R. & D. is due to;

(i) Imperfect appropriability of results; the innovator is not able to capture the full economic gain from his invention.

(ii) Uncertainty; the economic use of output from innovative investments may be so unsure that many firms, even large ones, may be unwilling to invest sufficient resources in such projects.

(iii) Indivisibilities; economies of scale and the need for pooling of risk may prohibit effective research for many firms below a critical size and serve to limit competition among the larger firms.

(iv) Imperfect Markets; the output of many projects will not be traded in perfect markets (i.e. urban transportation, health, educational technology, etc.) which may lead to a divergence between social returns and private incentives thus, inefficiencies in producing or distributing knowledge in these areas (Slitter, 1966, pp. 223-4).

The arguments against governmental incentive for R. & D. activities are that, it provides windfalls for some firms for doing what they normally do in a competitive economy. It distorts the choices of the market place and produce un-neutralities in the allocation of resources[1] (Surrey, 1971). The incentives tend toward permanence, thus leading to waste and inefficiencies (Wolfman, 1965).

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[1] This would happen, tautologically, since that is what the incentives are supposed to do.

Governmental activities to stimulate R. & D. activities take a variety of forms. These include patent protection, regulatory and anti-trust policies, direct government spending via agencies and government sponsored laboratories, technical information services, support of education and training of scientists, engineers, and technicians, and favorable provisions in the tax code. Among all the incentives, the focus in this study is solely on the effect of tax incentives on investment in research and development. In general, one can safely say that there has been almost no evaluation of the effectiveness of tax policies for stimulating R. & D. (Kaplan, et. al., 1976, Executive Summary, p. 2).

Paquet (1971) examined the case for R. & D. tax incentives in Canada which had a variety of assistance programs and tax incentives for R. & D. since 1960. Paquet estimates that the Canadian government paid for 40 to 55 percent of the scientific activities of industry in the 1960's and also observes that "one can not find much evidence that these programs and policies have been seriously evaluated" (Paquet, 1971, p. 431). Kaplan (1976, Chapter 1, p. 76) writes "it is also impressive how little is known about the effects of any of the tax incentives or direct government subsidies on R. & D. and innovative activities. Writer after writer indicated our lack of knowledge in this area." Thus this study is undertaken as a pilot study of IRDIA and its effect on R. & D. and innovative activities. The next section presents a summary of various R. & D. Tax Acts of Canada, followed by the sample selection and data collection and the results of the survey.

A Brief Review of R. & D. Incentives Acts of Canada

An amendment to the Income Tax Act in 1962 introduced Section 72A which permitted a corporation that carried on business in Canada to claim an additional allowance of 50% of the increase in R. & D. expenditures made in Canada, over expenditures made in the last taxation year that ended April 11, 1962. The additional allowance applied to both capital and current expenditures other than land and could be claimed from 1962 and subsequent taxation years ending before December 31, 1966.

Prior to the enactment of Section 72A, deductions from income for scientific expenditures was contained in Section 72 of the Income Tax Act. Section 72 permitted a taxpayer who carried on business in Canada to deduct, in computing income for a taxation year, all expenditures for R. & D. (current and capital) made in Canada that year and all current expenditures made outside Canada. Capital expenditures made outside Canada, the taxpayer could only deduct the lesser of the amount of expenditure (other than the cost of land) or the capital cost of the property at the end of the taxation year. The taxpayer did not have to conduct the research himself to be eligible for the deduction under Section 72. As long as the research was related to his class of business, the taxpayer was allowed to deduct all payments made to approved associations, universities, institutions, nonprofit corporations resident in Canada and constituted for conducting research and any other corporation resident in Canada. Payments made to acquire patents and copyrights were not deductible under Section 72.

While the regulations governing Sections 72 and 72A were similar in most cases, there were some differences. For example, Section 72 applied to the "taxpayer", while Section 72A applied to the "corporation." This meant that syndicates, trusts, partnerships, and proprietorships could claim a deduction under Section 72, but not under Section 72A.[2]

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[2] Section 72A of the Tax Act of Canada and IRDIA can be viewed as very similar to that of Research and Experimentation Incentives provisions of E.R.T.A. of 1981.

Section 72A of the Income Tax Act was replaced by the Industrial Research and Development Incentives Act (IRDIA) on March 10, 1967.

IRDIA was enacted with the following principal features:

(1) It provided for a grant of 25% of eligible capital expenditures.

(2) It provided for a grant of 25% of the amount by which eligible current expenditures on research and development exceeded the average of such expenditures made in the preceding five years.

IRDIA grants were exempt from income tax by virtue of Section 9 (1) of the act creating it. This specific exemption emphasized the basic premise upon which the IRDIA program rested, namely that IRDIA grants were additional incentives offered to Canadian industry designed to supplement the 100% deduction of all research and development expenditures allowed under the Income Tax Act (very similar to the tax credit provisions of ERTA, 1981).

The benefits of IRDIA grants were available only to taxable corporations incorporated in and carrying on business in Canada. Corporations which were exempt under Section 149 of the Income Tax Act, such as charitable organizations, non-profit corporations, co-operatives and personal corporations, could not apply for IRDIA grants. Similarly, non-corporate firms, non-resident firms and Canadian corporations which did not carry on business in Canada were also precluded from IRDIA assistance. However they could take advantage of Section 72.

The objectives of IRDIA were perceived to be the following (Statistics Canada, 1969):

(1) To encourage an increased growth rate in industrial R. & D. by inducing Canadian corporations to undertake new scientific research

problems and expand on existing ones.

(2) To encourage the establishment of independent research laboratories, research associations and technical consulting services whose purpose was to provide specialized support services for industrial research and development.

(3) To encourage greater co-operation between industry and universities on research related to industrial problems.

(4) To increase technological innovation contributing to the economy as a whole.

The next section describes the questionnaire and the sample selection for the study.

Sample Selection and Data Collection

The method of data collection is a questionnaire survey. A copy of the questionnaire and the tabulated data are presented in the appendix. The questionnaire was pilot tested to make it understandable to the sample and also to keep it to a manageable length. As a result some aspects of IRDIA could not be studied. The thrust of the questionnaire is to determine the following:

(1) the patterns of expenditures for R. & D. by class of industries and technologies,

(2) the impact on the length of the R. & D. projects due to tax incentives,

(3) and, the extent of successful development of technologies and the commercial exploitation there-of.

The above determinations will help in evaluating the achievement of objectives one and four described above.

A list of companies that had utilized the tax incentive programs was obtained from the commerce Ministry of Canada. The list constituted approximately 180 firms with high research concentration. Of the 180 firms, a random sample of 60 firms was selected for the study.

Before the survey was conducted the questionnaire was pilot tested using another group of 30 companies, selected at random from the remaining 120 firms. The questionnaires were mailed to the 60 selected firms during the summer of 1983. The replies were to be returned in a self addressed envelope. To maintain anonymity, no identifying information was requested. Out of the 60 selected firms, 51 firms returned the questionnaire, representing a return of 85 per cent. However, eight returned questionnaires were unusable, resulting in 43 usable returns. The next section presents the empirical (survey) results.

RESULTS AND ANALYSIS

Overview

The most important result of the survey is that during the IRDIA years, the R. & D. projects undertaken were of longer duration (overall) compared to that of post-IRDIA years (Table 9 & 13). The implication of this result is that, IRDIA incentives for R. & D. did induce companies to undertake projects requiring longer periods to complete. To that extent IRDIA achieved one of its objectives. However, one could argue that, the post-IRDIA R. & D. undertaken by the firms probably concentrated on the commercial aspects (final products) of the innovations developed during the IRDIA period.

The second important result of the survey is that the younger firms (0-5 years) had the highest success rate (80%, Table 6) in producing commercially successful products in the high technology field. The more mature companies (6 years and older) enjoyed a relatively higher success rate in the medium and the low technology field (Table 7 & 8). Furthermore, there is no difference between the consumer goods and the capital goods companies in their overall commercial success rate (Table 4). It is the nature of technology and the age of the firms that had bearing on the success rate. However, diversified companies did have a higher overall rate of success than the other two groups (Table 4).

The policy implication of the above result is that the younger firms that lack a profit base should be allowed to apply the tax credit over a longer period or whenever their profit situation allows them to avail the tax credit or some kind of differential tax policy. The detailed results are presented in the next section.

Detailed Results:

The firms that utilized (tax) incentive programs during IRDIA, approximately 42 percent identified themselves as capital goods manufacturers, 35 percent as consumer goods manufacturers and the rest (23 percent) were diversified companies. The majority of the firms (approximately 59 percent) that took advantage of the program were older firms that were in existence twenty years or more. The rest of the 41 percent were distributed as follows: approximately 11 percent were in existence for five or less years, 17 percent were between six and 10 years old, and 13 percent were between 11 and 20 years old. From the analysis of questions one and two it can be inferred that the majority of the firms that participated in the IRDIA program were older firms specializing in capital goods sector of the economy.

The first objective of the IRDIA program was to provide incentives for the companies to engage in long term R. & D. in order to develop new technologies and the fourth question of the survey attempted to assess this aspect of the objective. Based on the answers to question four (#4), it appears that during the IRDIA period (1966-76) approximately 54 percent of the R. & D. budget of the firms (surveyed) was devoted to development of new technologies and 46 percent to improvement of existing products and technology. However, the situation reversed after the incentive period expired. Between 1976 and 1982 only 41 percent of the budget was devoted to developing new technologies and 59 percent of the R. & D. budget was devoted to improving current technology and products. To that extent, tax incentives to induce firms to undertake more risky R. & D. projects, i.e. development of new technology was effective, and IRDIA appears to have succeeded in this objective based on the survey data.

However, one could argue that the reversal in the allocation of R. & D. budget during the post IRDIA period was to be expected. Because the technologies that were developed during the IRDIA period needed to be perfected commercially, thus they fell into the category of existing technology. In other words, the classification changed with time, whereas the projects did not. On the other hand it can be argued that the tax incentive program would have completely failed if there were no difference in the allocation of R. & D. budget during the IRDIA and post IRDIA period.

The data were further analyzed to determine if the overall pattern of R. & D. budget allocation was repeated among the categories of firms. This was done to determine whether there were differences or similaries and what the implications might be. To provide an answer to this inquiry, questions one and four were cross-classified and analyzed and the tabulation is presented in Table 1. The results are, consumer goods firms during IRDIA period (66-76) allocated approximately 57 percent of R. & D. budget to improve existing technology and 43 percent to develop new technology. During the post IRDIA period (77-82) the allocations are 68 percent and 32 percent respectively for the same group. Thus a higher percent of R. & D. budget (43% vs. 32%) was allocated to develop new technologies during the IRDIA period.

The capital goods firms during the IRDIA period allocated 35 percent of the R. & D. budget to improve existing technology and 65 percent to develop new technology. The allocations for the post IRDIA period were 46 percent and 54 percent respectively. Again a higher percent of R. & D. budget (65% vs. 54%) was allocated to develop new technologies during the IRDIA period.

The diversified firms allocated approximately 57 percent of the R. & D. budget to improve existing technology and 43 percent to develop new technology during the IRDIA years. During the post-IRDIA period the allocations were 48 percent and 52 percent respectively. It appears that the allocations are reversed between these two periods. An inference that can be drawn is that the IRDIA incentives (i.e. tax incentives) did not influence the diversified firms to allocate higher R. & D. resources to develop new technologies. However, all firms taken as a group did allocate higher percent of R. & D. to develop new technologies during the IRDIA years.

The data were further analyzed to ascertain the extent of unexpected benefits if the R. & D. efforts were unsuccessful in achieving intended objectives. This was ascertained from answers to question five of the survey. If the R. & D. expenditures have some expectancy of unexpected benefits, the firms might be willing to undertake them without the tax incentives. However, if the fall-out benefits are very rare or infrequent, a strong case for tax incentives could be made to reduce losses. In Table 2 the results of the survey (Q #5) are presented and it is apparent that the consumer goods industries have the best unexpected results. About 74 [(4+22)/35(Total)] percent of the firms had very often and occasional unexpected realized benefits. Hence, one can infer that for the consumer goods industries the R. & D. expenditures can lead to unexpected benefits even if they do not achieve intended objectives.

The data were further analyzed to determine if the unexpected benefits were also dependent on the age of the firm as opposed to type of firm. This was accomplished by cross-classifying the answers to question two and question five. From the data it appears that the mature firms with 20 or more years in operation had substantially higher success in harnessing unexpected benefits. Table 3 summarizes the unexpected benefits from R. & D. expenditure by the age of the firms.

The study also tried to ascertain the success of R. & D. expenditures in terms of identifiable end products and commercial success. The objective being to provide a (rough) probability estimate of achieving the R. & D. project objective and probability of commercial success for the 1967-1982 period. From these probabilities a firm may estimate its expected pay-off matrix. The tabulated data is presented in Table 4.

The results of cross tabulation of question one and question seven are (presented in Table 4), consumer goods firms experienced 12% success rate in achieving the objectives of R. & D. in high technology goods. Out of these 12% only 36% achieved commercial success. For the medium technology goods the technological success rate was 39% and the corresponding commercial success rate was 52%. For the low technology goods the technical success rate was 49% and the corresponding commercial success rate was 63%. These results are graphically presented in Figures 1 and 2. The basic pattern, for both the technological achievement and commercial success, is increasing from high to low technology. However the classification of technology into high, medium and low is based on each firm's perception. They were not given any benchmark as reference.

The firms engaged in capital goods industries experienced 46 percent success rate in high technology R. & D. in achieving its goals. And almost

49 percent of these successful projects achieved commercial success. The success rate for medium technology R. & D. projects were 38 percent but the commercial success rate was almost 62 (61.43) percent. The corresponding statistics for low technology R. & D. were 16 percent and 63 percent. The general conclusion is that the success rate of achieving the objectives of R. & D. projects is a decreasing function from high to low technology. However, commercial success rate is an increasing function. Figures 3 and 4 depict the phenomena graphically.

The success rates for the diversified group are 35 percent, 40 percent and 25 percent for high, medium and low technology R. & D. projects, respectively. The trend in this group is a mixture. First the rate increases with decline in technology, then declines. The commercial success rates are 55 percent, 60 percent and 86 percent respectively also. Figures 5 and 6 present the results graphically. The trend however of commercial success in all three groups are similar, i.e. the lower the technology the higher the commercial success.

A general conclusion that can be drawn from the data is that the technological success rate for the capital goods and diversified firms are fairly high for high technology products. But the commercial success rates are roughly equal among all three categories of firms. Thus from a policy point of view, tax incentives for high technology R. & D. projects are quite desirable.

The next analysis was performed to determine if the age of the firms had any influence on the commercial success of the R. & D. expenditures. If there is a discernable influence, then a differential tax incentive policy could be called for. The data for analysis in this section is presented in Tables 5, 6, 7 and 8.

The results for the firms of five years old or less are, 52 percent of the R. & D. expenditure was devoted to high technology research, 36 percent was devoted to medium technology research and 12 percent was devoted to low technology research. The commercial success rates for high technology projects were 80 percent, for medium technology it was 43 percent and for the low technology it was only 40 percent. For the firms that were between six and ten years old (inclusive) the R. & D. expenditures were 39 percent, 42 percent and 19 percent for the high technology, medium technology and low technology respectively. The commercial success rates were 23 percent, 66 percent and 80 percent respectively for those projects.

The results for the firms between 11 and 20 years old (inclusive) are, the R. & D. expenditures were 25 percent, 63 percent and 12 percent for the high technology, medium technology and low technology, respectively. The commercial success rates were 60 percent, 80 percent and 90 percent for the high technology, medium technology and low technology projects, respectively. For the firms that were over 20 years old the R. & D. expenditures were 27 percent, 37 percent and 36 percent for the high technology, medium technology and low technology projects. The commercial success rates were 47 percent, 59 percent and 70 percent, respestively, for those projects.

The general overall results are, the younger firms are spending more (as a percent of their R. & D. budget) on high technology projects compared to the older firms and also realizing a higher rate of commercial success. The older firms are spending more for the medium and low technology projects and also realizing a higher rate of success compared to the younger firms. The implication is if we need to stimulate high technology research, the younger firms should be provided with higher tax incentives. What is surprising is that the more established firms did not spend more for high technology research projects. They could afford to take high risk because of their higher earnings and tax bracket. The younger firms generally can not take advantage of tax loss carry back.

In this section we deal with an important objective of IRDIA, i.e. did incentives for R. & D. give rise to the technologically advanced projects? A basic assumption that is being made is that a technologically advanced project on average requires longer time to complete. Hence we shall be testing for differences in the mean length of the projects during the IRDIA period and after the IRDIA period. The statistics of the projects are divided into three categories, i.e., the youngest, the most and the oldest projects. The rationale for the categorization is to estimate the mean of a β (beta) distribution. The β (beta) distribution has been found to be a good approximation for project duration times and number of projects undertaken during a period (Moder and Phillips 1970). The required statistics for hypothesis testing are presented in Table 9.

Using the data presented in Table 9 we can test for the hypothesis $(\mu_1 = \mu_2)$ for each class of projects and for all projects to determine if there were any differences statistically in the lengths of projects undertaken during and after the IRDIA period. The data that we have is essentially from group paired experiment (Huntsberger, 1970, p. 216). Hence a group "t" statistics can be used for testing the equality of means. The tests are presented in Table 10 through 13.

The results (Table 12) of the statistical tests are that the long-lived projects undertaken during IRDIA were of longer duration than the corresponding projects after the IRDIA period. If it can be assumed that high technology R. & D. projects require a longer time period for completion then the tax incentives during IRDIA achieved its objective. From Table 13 (which presents overall test) it can be concluded that the average age of all R. & D. projects during IRDIA period was higher than that after the IRDIA period. Thus the tax incentives during IRDIA period produced the desired overall effect as well as specific effects. Given the results in Table 10 and 11 which are not significant, it is obvious that the results in Table 12 dominate the overall results presented in Table 13. Hence longer lived R. & D. projects dominated the IRDIA period. These results are also confirmed in Table 10A, 11A and 12A, which uses an approximate (simple t-test) alternative test (Huntsberger, 1970, p. 209).

Summary, Conclusions and Limitations

The objective of this study was to empirically study the impact of tax credit for research and development activities in private firms. The Industrial Research and Development Incentives Act (IRDIA) of Canada was selected for the study because of its generous provisions and the act was perceived to provide general encouragement for R. & D. An instrument of questionnaire was used to collect data for the study.

The first important finding of the study is that during IRDIA period the long-term R. & D. projects undertaken were of longer duration than that of post IRDIA period. This may imply that the firms were willing to invest in long-term research due to availability of tax incentives for R. & D. If it can be assumed that in general long-term research leads to development of high technology, thus contributing to general economic well-being, then IRDIA did achieve one of the perceived objectives. Probably one could expect similar results under 1981 Economic Recovery Tax Act in U. S. A.

The second finding is, it is the younger firms (0-5 years) that enjoyed the highest success rate in the field of high technology both in terms of technological success and commercial success. From a tax policy point of view, this result implies that younger firms engaging in high technology

R. & D. projects should be given differential tax treatment. Possibly they could be given higher tax credit or a longer period for tax loss carry forward. IRDIA however, did not provide for any differential treatment.

The third finding is that there is no significant difference in the success rate (commercial) among the various classifications i.e. consumer goods companies, capital goods companies and the diversified companies. Which may imply that it is not necessary to differentiate various sectors of the economy for R. & D. tax credit.

The fourth result of the study is that IRDIA was quite successful in diverting R. & D. funds to developing new technologies compared to post-IRDIA period, except for the diversified companies (Table 1). However the overall results indicate that a larger portion (54%) of R. & D. was devoted to developing new technologies during the IRDIA period compared to that of the post-IRDIA period. To that extent IRDIA contributed to the technological innovations, which was one of its perceived objectives. But the situation exactly reversed after the IRDIA period. The implication of this reversal is that, if the point of the tax credit is to promote R. & D. what's needed is steady support that companies can count on for their long-term planning (Brown, 84). However, it could be fine-tuned in terms of shifting of funds within the overall R. & D. budget, as seen from Table 1 and also promote the spending. In a previous study (Department of Industry, Trade & Commerce, 1981, p. 14) it was reported that IRDIA did promote increased R. & D. spending.

The limitation of the study is that it based on a questionnaire survey and limited data, with its accompanying shortcomings. Furthermore there were a number of grant programs (and tax incentives) in effect at the time of IRDIA, making it difficult even with statistical techniques to isolate their separate influences. Also the firms did not provide the data on their asset size, thus limiting the analysis further. Because of the confidentiality provisions of the Act, access to individual company files was also not possible. As a result the study is only aggregate in nature.

In conclusion, the most important empirical result of the study is that, governmental incentives to promote research and development activites of private enterprises is effective and produces results in the intended and desired direction.

TABLE 1

R. & D. EXPENDITURES (PERCENTAGE) BY TYPE OF (INDUSTRY) FIRM DURING IRDIA AND POST IRDIA PERIODS (CROSS CLASSIFICATION OF Q#1 & #4)

Type of Firm	Class of R. & D. Expenditures	IRDIA Period (66-76)	POST IRDIA Period (77-82)
Consumer Goods	To improve existing technologies	57%	68%
	To develop new technologies	43%	32%
Capital Goods	To improve existing technologies	35%	46%
	To develop new technologies	65%	54%
Diversified (Other than the above Categories)	To improve existing technologies	57%	48%
	To develop new technologies	43%	52%
All firms	To improve existing technologies	46%	59%
	To develop new technologies	54%	41%

TABLE 2

TYPES OF INDUSTRY AND REALIZED UNEXPECTED BENEFITS FROM R&D EXPENDITURES
(CROSS CLASSIFICATION OF Q #1 & #5)

Frequency of Realized Unexpected Benefits	Type of Industry		
	Consumer Goods	Capital Goods	Diversified
Very Often	4%	7%	0%
Occasionally	22%	19%	9%
Rarely	9%	14%	14%
Never	0%	2%	0%
Don't Know	0%	0%	0%
Total	35%	42%	23%

TABLE 3

UNEXPECTED BENEFITS FROM R&D EXPENDITURE
CLASSIFIED BY THE AGE OF THE FIRMS
(CROSS CLASSIFICATION OF Q #2 & #5)

Frequency of Realized Unexpected Benefits	Age of the Firms			
	0-5 Years Old	6-10 Years Old	11-20 Years Old	>20 Years Old
Very Often	2 Percent	4 Percent	0 Percent	6 Percent
Occasionally	9 Percent	2 Percent	7 Percent	33 Percent
Rarely	0 Percent	7 Percent	2 Percent	28 Percent
Never	0 Percent	0 Percent	0 Percent	0 Percent
Don't Know	0 Percent	0 Percent	0 Percent	0 Percent
Total	11%	13%	9%	67%

TABLE 4

R. & D. TECHNOLOGICAL AND COMMERCIAL SUCCESS (CROSS CLASSIFICATION OF Q#1 & Q#7)

Industry	Technology	R.&D. Technological Success Relative Percent		Commercial Success (Percent) given Technological Success		Overall Commercial Success (Percent)
Consumer Goods	High	12	(15)*	36	(7)*	55.47
	Medium	39	(15)	52	(13)	
	Low	49	(14)	63	(11)	
Capital Goods	High	46	(18)	49	(14)	55.80
	Medium	38	(18)	61	(14)	
	Low	16	(18)	63	(11)	
Diversified	High	35	(10)	55	(8)	64.75
	Medium	40	(10)	60	(9)	
	Low	25	(10)	86	(5)	

*Numbers in the brackets ( ) are number of respondents to Q#7 on the questionnaire.

Table 5

Age of the Firms and R. & D.
Expenditures Classification

Yrs.	High Tech.	Medium Tech.	Low Tech.
0-5	52%	36%	12%
6-10	39%	42%	19%
11-20	25%	63%	12%
> 20	27%	37%	36%

Age of the firms and the Commercial
Success by the Class of Technology

Table 6

Yrs.	High Tech.	
	Success	No Suc.
0-5	80%	20%
6-10	23%	77%
11-20	60%	40%
> 20	47%	53%

Table 7

Yrs.	Medium Tech.	
	Success	No Success
0-5	43%	57%
6-10	66%	34%
11-20	80%	20%
> 20	90%	10%

Table 8

Yrs.	Low Tech.	
	Success	No Success
0-5	40%	60%
6-10	80%	20%
11-20	90%	10%
> 20	70%	30%

TABLE 9

Statistics of R&D projects' longevity during
and after I.R.D.I.A. period

	During	IRDIA	After	IRDIA
	$\bar{\mu}_1$ Mean yrs.	σ_1 Std.dn.	$\bar{\mu}_2$ Mean yrs.	σ_2 Std.dn.
Youngest Projects	0.91	0.2	0.926	0.187
Most Projects	2.15	0.66	2.175	0.85
Oldest Projects	5.82	1.45	3.53	1.19
All projects (assuming β distribution)	2.56	1.53	2.193	0.81

Table 10

Equal means test for the Youngest (Shortest) Projects

Treatment	n	df	$\bar{\mu}$	Sum of Squares	Statistics
During IRDIA	36	35	0.91	10.932	$S_2^2 = 0.375$ $S_d^2 = 0.019$ $S_d = 0.138$ $^*t = -0.116$
After IRDIA	43	42	0.926	17.915	
Sum	79	77		28.847	*not significant at 0.05 level

Under the hypothesis $\mu_1 = \mu_2$, the 't' statistic (Huntsberger, 1970, p. 359) is not significant. Hence we conclude that IRDIA had no affects on short lived projects.

TABLE 11

EQUAL MEANS TEST FOR THE MOST PROJECTS

Treatment	n	df	$\bar{\mu}$	Sum of Squares	Statistics
During IRDIA	33	32	2.15	44.2215	$s_2^2 = 1.465$ $s_d^2 = 0.0366$ $s_d = 0.1914$ $*t = -0.1306$
After IRDIA	40	39	2.175	59.764	
Sum	73	71		103.9855	* not significant at 0.05 level

The 't' statistic (Huntsberger, 1970, p. 359) is not significant for the most projects. Using this analysis we conclude that IRDIA did not affect the longevity of most (normal) R. & D. projects.

TABLE 12

EQUAL MEANS TEST FOR THE OLDEST (LONGEST) PROJECTS

Treatment	n	df	$\bar{\mu}$	Sum of Squares	Statistics
During IRDIA	38	37	5.82	250.81	$s_2^2 = 4.94$ $s_d^2 = 0.267$ $s_d = 0.52$
After IRDIA	36	35	3.53	104.94	
Sum	74	72		355.75	$t = 4.4*$ *significant

The "t" statistic (Huntsberger, 1970, p. 359) is significant and the hypothesis μ_1 (during IRDIA) $= \mu_2$ (after IRDIA) is rejected at 0.05 level of significance (in one-tail test). Hence the alternate hypothesis $\mu_1 > \mu_2$ can not be rejected.

Table 13

Equal means test for all projects
(Simple t-test)

Treatment	n	$\bar{\mu}$	σ	Statistics
During IRDIA	107	2.56(μ_1)	1.53	S_d = 0.166 t = 2.211* *significant at 0.05 level
After IRDIA	119	2.193(μ_2)	0.81	

The 't' statistic (Huntsberger, 1970, p. 209,356) is significant and the hypothesis of $\mu_1 = \mu_2$ is rejected at 0.05 level of significance. Hence the alternative hypothesis of $\mu_1 > \mu_2$ can not be rejected.

Alternative (approximate) tests for (Table 10, 11 & 12)

Table 10A

Treatment	n	$\bar{\mu}$	σ	Statistics
During IRDIA	36	0.91	0.2	Sd = 0.044 t = -0.364*
After IRDIA	43	0.926	0.187	*Not significant

Table 11A

Treatment	n	$\bar{\mu}$	σ	Statistics
During IRDIA	33	2.15	0.66	Sd = 0.177 t = -0.1412*
After IRDIA	40	2.175	0.85	*Not significant

Table 12A

Treatment	n	$\bar{\mu}$	σ	Statistics
During IRDIA	38	5.82	1.45	Sd = 0.31 t = 7.387*
After IRDIA	36	3.53	1.19	*Significant at 0.05 level

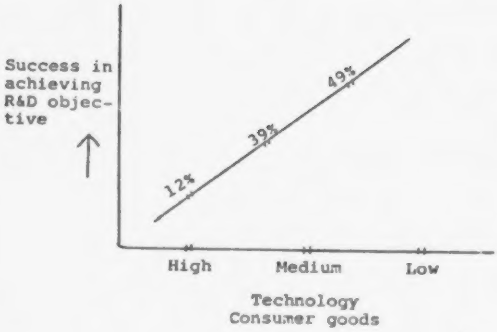

Figure 1

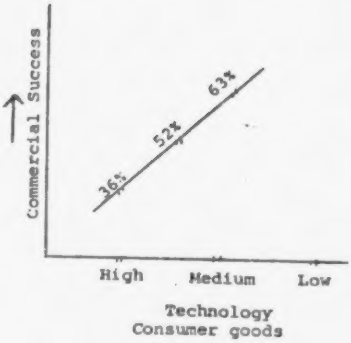

Figure 2

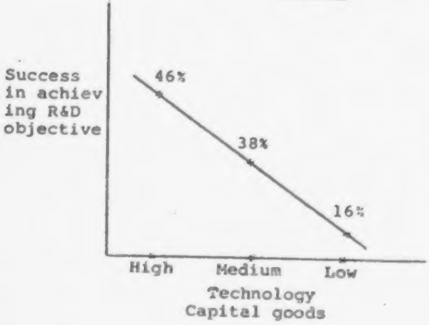

Figure 3

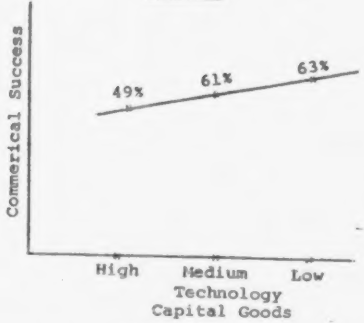

Figure 4

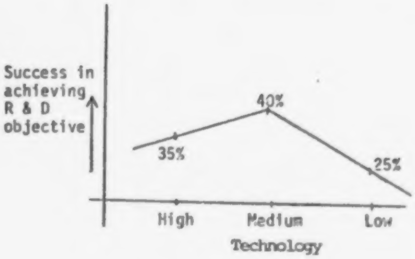

Figure 5

Diversified (other than Capital and Consumer goods).

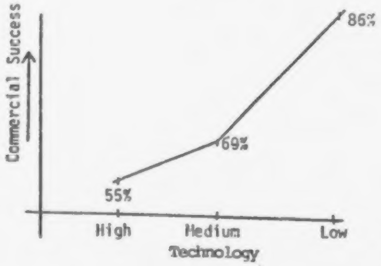

Figure 6

Diversified (other than Capital and Consumer goods).

APPENDIX

QUESTIONNAIRE AND TABULATED RESULTS OF SURVEY

SURVEY - RESEARCH AND DEVELOPMENT INCENTIVES

Q.1: In which of the following categories can your firm best be classified? (Check only one)

☐ consumer goods,
☐ capital goods (non-consumer),
☐ diversified (other than the above two categories).

Q.2: How long has your firm been in operation? (Check only one).

0-5 years	6-10 years	11-20 years	over 20 years
☐	☐	☐	☐

Q.3: What was the total asset size (approximately) of your firm during the following years?

1967___________ 1972___________ 1976___________

Q.4: Research and development expenditures have been viewed as a necessity for development of new technologies and improving existing products and technologies, to maintain competitive position in the industry and the world.

Please provide approximate percent distribution of R.&.D. expenditures in your firm.

	Between 66-76	Between 77-82
(Improvement of existing products and technology)	_______	_______
(Development of new technologies and products)	_______	_______

Q.5: Based on your experience, how often does research that is not successful in achieving its intended objectives lead to unexpected benefits?

Very Often	Occasionally	Rarely	Never	Don't Know
☐	☐	☐	☐	☐

Q.6: From a long-range planning point of view, research commitments are vital. In your company:

(i) How many research projects are currently in progress?_______

(ii) How long have the youngest project, the oldest project, and the most projects been in existence?

Youngest:_____yr(s) Oldest:_____yr(s) Most:______yr(s)

(iii) What was the length of the longest project, the shortest project and the most project undertaken by your firm during the time when IRDIA was in effect? (1966-76).

Longest:_____yr(s) Shortest:_____yr(s) Most:_____yr(s)

Q.7: Based on past experience, about what percentage of your R. & D. expenditures would you say are identifiable with projects which resulted in final products (irrespective of commercial values) and how would you classify them? (i.e. High, Medium and Low Technology).

	High	Medium	Low
Percentage	________	__________	________
What percent of each were commercial success	________	__________	________

If you would like a summary of this research please fill in the following, cut along the dotted line and mail it back to me in a separate envelope to preserve the confidentiality of your response. Otherwise, you may return this as it is.

- -

Name: ____________________________________ Telephone # __________________________

Company: ____

St. Name & No. ____
(Address)

CANADA

SURVEY TABULATION

Question No. 1.

	Consumer Goods	Capital Goods	Diversified	Total
No. of Respondents	15	18	10	43
Percent	35%	42%	23%	100%

Question No. 2.

	Years 0-5	Years 6-10	Years 11-20	Years >20	Total
No. of Respondents	5	7	4	27	43
Percent	12%	16%	9%	63%	100%

Question No. 3. Firms did not reply.

Question No. 4. (Also see Table 1)

		Between 66-76	Between 77-82
No. of respondents	Improvement of existing Products & Technology	38	43
	Development of new technologies & Products	37	42

Question No. 5. (Also see Table 2 & 3)

	Very often	Occasionally	Rarely	Never	Don't know	Total
No. of respondents	5	21	16	1	0	43
Percent	12%	49%	37%	2%	0%	100%

Question No. 6.

(1)	Number of research projects currently (82)								
	1	2	3	4	5	6	7-15	16	Total
No. of respondents	4	9	5	7	5	5	4	4	43
Percent	9	21	12	16	12	12	9	9	100%

(ii) & (iii)

(also see Table 10)

	Youngest projects - post IRDIA			
No. of years	0.4	1	2	Total
No. of respondents	22	11	10	43
Percent	51	26	23	100%

	Shortest projects - during IRDIA			
No. of years	0.43	1	2	Total
No. of respondents	16	14	6	36
Percent	44	39	17	100%

(also see Table 12)

	Oldest projects - post IRDIA								
No. of years	1	2	3	4	5	6	7	8	Total
No. of respondents	3	7	13	3	4	4	1	1	36
Percent	8	20	36	8	11	11	3	3	100%

	Longest projects - during IRDIA								
No. of years	1	2	3	4	5	6	7	8-18	Total
No. of respondents	1	5	6	4	7	3	3	9	38
Percent	2	13	16	11	18	8	8	24	100%

(also see Table 11)

	Most projects - post IRDIA						
No. of years	1	2	3	4	5	6	Total
No. of respondents	14	14	6	4	1	1	40
Percent	35	35	15	10	2.5	2.5	100%

	Most projects - during IRDIA						
No. of years	1	2	3	4	5	6	Total
No. of respondents	10	15	4	1	3	0	33
Percent	30	45	12	3	10	0	100%

Question No. 7. (see Tables 4, 5, 6, 7 and 8).

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Chairman RANGEL. The next panel is John Hickey, executive vice president and chief financial officer, Motorola, representing the Semiconductor Industry Association; Mike Miller, vice president-treasurer of Gould, Inc.; Thomas Bryan, chairman, Committee on Capital Availability and Development of the New England Council; and Marc H. Rosenberg, executive director, National Coalition for Science and Technology.

STATEMENT OF JOHN T. HICKEY, EXECUTIVE VICE PRESIDENT AND CHIEF FINANCIAL OFFICER, MOTOROLA, INC., REPRESENTING THE SEMICONDUCTOR INDUSTRY ASSOCIATION

Mr. HICKEY. Thank you, Mr. Chairman. I am John Hickey. I am executive vice president and chief financial officer of Motorola, Inc., headquartered in Schaumburg, a suburb of Chicago, IL. Motorola is one of the world's leading manufacturers of electronic equipment and components. We employ more than 90,000 people more than 66,000 in the United States.

Because semiconductors are the basic components of many high tech products, a thriving and relatively successful semiconductor industry is very important to the entire high tech segment of American industry. In its worldwide contest with aggressive Japanese competitors, the U.S. semiconductor producers incur the disadvantage of a non-leveled field in many ways including the artificially low cost of capital that the Japanese have.

This enables the Japanese firms to better afford the very expensive assets required for the processing of semiconductors, and to do so at a faster rate. It also enables them to be satisfied with a lower return on investment and therefore to afford higher spending on research and development.

The R&D tax credit which first became effective in 1981 has enabled U.S. firms to partially close this gap in affordable R&D and thereby partially level the playing field. For Motorola, qualified R&D expenditures grew by 80 percent from 1980 to 1983, increasing from less than 4 percent of sales to 5½ percent in 1982, the first complete year in which the credit was in effect.

Our R&D spending has remained at this higher percentage of sales consistently since then. Had our 1983 R&D expenditures been limited to the pre-1981 percentage of revenues we would have spent more than $81 million less on R&D in 1983. The increased rate of R&D spending took place in the 1982 and 1983 recession years, despite the fact that virtually all other rates of expenditures were being reduced and the margins were down.

As a direct participant in these corporate budgetary decisions I can state unequivocally that the R&D tax credit was a principal factor in the decisions to increase the rate of R&D spending despite the recession and despite lower earnings. Let me now show you an example of the relationship between competitively attractive semiconductor devices and the large amounts of research and development required for their creation.

I hold in my hand a recently announced Motorola product, the MC-68020, a 32-bit microprocessor which my firm believes is the most sophisticated mainframe computer on a chip device that has thus far been designed by any semiconductor manufacturer in the world. The three-eighths inch square material which is at the heart of this device contains approximately 200,000 transistors, and the device has the data-processing capability of a large main-frame computer.

The design of this device began in 1981. One of our competitors who recently introduced such a device has publicly indicated that the design of its product cost $80 million. Also for research and development to be effective, the programs must be well planned, and they usually extend over a number of years, particularly for high technology industries and even more so for semiconductors.

With the R&D tax credit currently scheduled to expire at the end of 1985, U.S. semiconductor manufacturers are now faced with near-term decisions on reducing the level of R&D expenses. Budgetary decisions are being made this fall in the environment of surprise and disappointment that the extension of the credit was not contained in the recent legislation, despite what we perceived as a positive feeling in the Senate and sponsorship by majority of the members of the Ways and Means Committee and of the subcommittee, from both sides of the aisle.

Unless there is a basis for expecting that the credit will be made permanent or substantially extended, I would expect 1985 planning, which will take place this autumn, to seriously consider a reduced rate of R&D spending in late 1985, because of concern over the running rate of that expenditure going into 1986, a year in which a number of economists are looking at lower rates of growth.

The immediate enactment of legislation making the R&D credit permanent is the single-most important tax legislative item on the agenda of SIA and its member companies; immediate, because the programs which the credit supports cannot be subject to short-term decisions. I thank you very much for your attention. If you would like to see the device, I would be glad to hand it up to you.

Chairman Rangel. Mr. Duncan is the expert on those in our subcommittee and will be looking into that, I am certain. Thank you, Mr. Hickey.

[The prepared statement and supplemental material follow:]

STATEMENT OF JOHN T. HICKEY, EXECUTIVE VICE PRESIDENT AND CHIEF FINANCIAL OFFICER, MOTOROLA, INC., ON BEHALF OF THE SEMICONDUCTOR INDUSTRY ASSOCIATION (SIA)

My name is John T. Hickey. I am Executive Vice President and Chief Financial Officer of Motorola, Inc., headquartered in Schaumburg, a suburb of Chicago, Illinois. Motorola is one of the world's leading manufacturers of electronic equipment and components. We employ more than 90,000 people worldwide. I am appearing before you today on behalf of the 56 companies of the Semiconductor Industry Association (SIA).

I appreciate this opportunity to appear before the Subcommittee to strongly urge that the tax credit for research and development (R&D) activities be made a permanent part of our tax law. The R&D tax credit currently is scheduled to expire in slightly more than a year. Legislation that would make the R&D credit permanent, H.R. 4475, has been co-sponsored by a majority of both Democrats and Republicans on the Ways and Means Committee and has been co-sponsored by 9 of the 11 members of this Subcommittee. Similar legislation making the R&D credit a permanent part of federal tax law passed the full Senate earlier this year.

The enactment now of legislation to make the R&D credit permanent is the single most important tax legislative priority of SIA and its members.

To enable the Subcommittee members to fully appreciate the critical need of the semiconductor industry for the R&D credit, let me give you an outline of the state of the industry itself.

THE U.S. SEMICONDUCTOR INDUSTRY FACES INTENSE COMPETITION IN WORLD MARKETS BY HIGHLY-SUBSIDIZED FOREIGN FIRMS

Although until now the U.S. semiconductor industry has been the world leader in semiconductor products, in terms of both technology and market share, the U.S. industry's leadership is under a severe challenge from foreign competitors, especially Japan. Despite the recent upturn in the economy, we face long-term trends which adversely affect our ability to compete in world markets. If current market trends continue, the Japanese semiconductor industry will pass the United States in worldwide market share in the 1990's. We do not intend to let this occur. As an industry, we have confidence in our ability to meet this competitive challenge, but our best efforts will not be successful without the type of favorable environment which the R&D credit helps to create.

The worldwide semiconductor industry is expected to continue its explosive growth throughout the remainder of the 1980's, not only in sheer volume but also in diversity of market applications. In 1983, world consumption of semiconductors reached $16.1 billion, a 24 percent increase over 1982. The world semiconductor industry supports, and in many cases makes possible, an approximately $200 billion world electronics market. Industry analysts predict that world semiconductor consumption will reach or surpass $50 billion before the end of this decade and will support a world high technology electronics market of over $500 billion.

However, while the worldwide semiconductor market continues to grow, Japanese companies are improving their share at the direct expense of U.S. industry. On a worldwide basis, the United States still is the leader with a 53 percent market share, but within the past year Japan's share increased by 3 percentage points to 39 percent. In 1983, Japanese sales in the world market increased by 35 percent over 1982, as compared with a 20 percent increase by U.S. companies. Japanese semiconductor companies increased their share of the U.S. market by 47 percent to a total U.S. market share of 14 percent. By contrast, the U.S. share of Japan's semiconductor market dropped from 10 percent to 9 percent at the same time as Japan's share of its own rapidly-growing market increased.

Sales in foreign markets are of extreme importance to the U.S. semiconductor industry. In the quarter century of their existence, U.S. semiconductor companies have fiercely competed in all markets worldwide and currently sell in the aggregate 35 percent of their production outside of the United States. If historical trends continue, there is reason to believe that within 10 to 15 years, 45 to 50 percent of U.S. semiconductor sales could be in international markets.

Success in this worldwide competition is determined by a company's ability to innovate at a pace which equals or exceeds the tremendous rate of technological change and increase in technological complexity. As recently as 1970, the semiconductor industry was producing memory circuits containing 1,000 elements of memory (or bits). At present, the industry standard is a dynamic RAM (random access memory chip) with over 64,000 elements on a chip; 256,000 element chips are now in early production. By 1989, some industry analysts speculate that the most advanced chips will contain over 1,000,000 memory elements.

These high rates of growth and increasing complexity dramatically increase the requirements of U.S. semiconductor companies for new capital. The U.S. semiconductor industry's investment in R&D is over 8 percent of sales -- the highest of any industry listed in the Business Week R&D survey -- as compared with an overall U.S. industry average of less than 3 percent of sales. To finance this high level of investment, the semiconductor industry must constantly generate fresh sources of capital. Accordingly, one of the most critical challenges facing the U.S. semiconductor industry today is the cost of its capital.

This cost of capital problem is not shared by American's major foreign competitor in the world semiconductor market, Japan. A study prepared in 1980 by Chase Financial Policy, an affiliate of Chase Manhattan Bank, establishes that the cost of capital for a typical U.S. semiconductor company is dramatically higher than for its typical Japanese competitor, in part because of the Japanese government subsidies discussed below. During 1980, a time of high interest rates, the study revealed that the cost of capital for the typical American semiconductor company averaged 17.5 percent, as compared with only 9.3 percent for the Japanese semiconductor industry. The study also demonstrated that, although U.S. semiconductor firms were compelled by U.S. capital markets to earn a return approximately equal to the cost of capital, Japanese lenders were much more patient with the Japanese semiconductor industry which fell short of covering capital costs with a return of only 7.5 percent. A recent study by Paine Webber Mitchell Hutchins, Inc. entitled "U.S. and Japanese Competition in the Semiconductor Industry" (December 20, 1982), confirms this analysis: "[The] average Japanese semiconductor company has a cost of capital that is at least 35% lower than its average equity-dominated U.S. competitor. * * * The lower cost of Japanese companies' capital means that the required rate of return on that capital is lower. Other things equal, the Japanese company requires less profit than the higher cost U.S. companies and can therefore price products lower."

This substantial advantage to our Japanese competitors in the cost of capital has permitted the Japanese semiconductor industry to achieve dramatic increases in its rate of capital investment and has contributed to the industry's continued dramatic increases in market share. In 1983, for the first time, the Japanese merchant (sellers as opposed to internal users of chips) semiconductor industry surpassed the U.S. merchant semiconductor industry in capital investment. The Japanese semiconductor industry's capital investment was $1.54 billion, as compared with $1.45 billion by its U.S. counterpart. By contrast, as recently as 1978, capital investment by U.S. merchant semiconductor companies exceeded their Japanese counterparts by nearly two to one. As a percentage of sales, capital investment by the Japanese semiconductor industry also far surpassed U.S. companies, with 30 percent of sales invested by Japanese firms as compared to 20 percent of sales by U.S. merchant semiconductor firms -- a fact directly attributable to the advantage enjoyed by our Japanese competitors in the cost of capital.

This tremendous advantage enjoyed by our Japanese competitors in the cost of capital also has been reflected in their more rapid rates of investment in costly R&D in the area of semiconductor technology. During the period from 1977 to 1983, R&D expenditures by the Japanese semiconductor industry have been in the range of 13-16 percent of sales, as compared with 8-12 percent of sales by U.S. competitors. The Japanese semiconductor industry has increased its R&D spending from approximately 40 cents per dollar of U.S. R&D expenditures in 1977 to 90 cents per dollar of U.S. R&D expenditures in 1983.

Indeed, if exchange rates and the differential in labor costs are taken into account, it is fair to say that Japanese semiconductor R&D expenditures, drawn from a much smaller sales base than U.S. R&D spending, equaled or exceeded R&D spending by U.S. semiconductor companies for the first time.

In the long term, the structural advantage enjoyed by the Japanese semiconductor industry -- lower cost of capital and indifference to current profitability -- will continue to work to the distinct disadvantage of American competitors, jeopardizing the ability of the U.S. semiconductor firms to earn a sufficient return to cover their capital costs and, therefore, jeopardizing their ability to compete.

Moreover, the support of Japan and our other foreign competitors for their semiconductor and computer industries goes far beyond the relative cost of capital. It includes: direct subsidies; research tax incentives, including an R&D tax credit in Japan that has been in place since the mid 1960's; research cartels; a sheltered domestic market; significant tax subsidies for investment in plant and equipment; and soft loans.

THE R&D TAX CREDIT IS A CRITICAL TOOL FOR MAINTAINING THE COMPETITIVENESS OF THE U.S. SEMICONDUCTOR INDUSTRY IN WORLD MARKETS

Other witnesses today are no doubt speaking on the positive impact the R&D credit has had on their R&D since its enactment. We share their view. At Motorola our R&D spending grew from 1980 to 1983 by 89 percent, increasing from less than 4 percent of sales prior to the R&D credit to 5.6 percent of sales in 1981, the first year in which the R&D credit was in effect. The level of R&D spending for Motorola has remained at this higher percentage of sales since 1981. In my opinion, this increase in our basic level of R&D spending which took place in 1981 was caused, in large part, by the R&D credit.

In my statement today I would like to focus in more detail on the impact of the R&D credit on the ability of U.S. semiconductor companies to raise the capital they need at a reasonable cost. Because of the manner in which the U.S. semiconductor industry raises capital, a crucial link exists between the industry's cost of capital and the effective tax rates borne by the industry. The bulk of the capital raised by the U.S. semiconductor industry comes from equity, rather than from debt financing. Most companies in the industry tend not to pay substantial dividends, but rather plow the great bulk of after-tax earnings back into their business, including substantial investments in R&D. Thus, retained earnings constitute a very important source of capital for the U.S. semiconductor industry. To the extent that the industry bears a disproportionately high U.S. corporate tax burden, this invaluable source of capital is seriously depleted.

Failure to extend the R&D credit not only will eliminate a valuable incentive for costly but vitally important

R&D activities, but also will mean that the semiconductor industry and the high technology electronics industry in general -- which already have among the highest effective tax rates in U.S. industry -- will have suffered, on net, a very substantial tax increase as a result of the combined effect of the 1981 (Economic Recovery Tax Act), the 1982 (Tax Equity and Fiscal Responsibility Act), and the 1984 (Tax Reform Act) Acts. A substantial reason for the enactment of the R&D credit was the recognition by Congress that ACRS depreciation changes did not provide any tax reduction for short-lived equipment like that used by high technology companies and that some other tax reduction measure was necessary if these companies were to retain any net benefit from the legislation.

Even with the enactment of the R&D credit, recent studies by industry, the Congressional Joint Committee on Taxation, and the publication Tax Notes clearly demonstrate that the high technology electronics industry bears a corporate tax burden that is high relative to U.S. industry generally. The Joint Committee analysis indicates that average effective tax rates on U.S. income for U.S. electronics companies in 1981 were 50 percent higher than that of U.S. companies generally.

Moreover, the Joint Committee study for 1982 indicates that, as the 1981 Act became more fully effective, this disparity in effective tax rates grew. The study concludes that overall corporate effective tax rates on U.S. income declined in 1982. At the same time, effective tax rates for the high technology electronics industry have remained high. Thus, in 1982 effective tax rates in the high technology electronics industry were as much as 60 percent higher than the effective tax rates of U.S. industry generally. A study by 20 companies from the high technology electronics industry established that if the R&D tax credit had not been enacted, the effective tax rates in the high technology electronics industry would have been 10 to 20 percent higher than their already disportionately high levels. Thus, allowing the R&D credit to lapse would exacerbate the disparity already present between high technology industries and other intensive industries with long-lived equipment that benefited greatly from ACRS.

The 1984 Tax Act is likely to have further worsened the tax rate disparity between the high technology electronics industry and the remainder of U.S. industry. One set of provisions which causes this result is the newly-enacted FSC (Foreign Sales Corporation) provisions. These provisions essentially establish a flat rate 15 percent exemption for certain U.S. exports. Yet, the provisions replace DISC, under which export tax benefits were computed on an incremental basis that favored fast-growing companies. Under DISC many semiconductor companies enjoyed tax reductions on as much as 22 percent of their export income. We do not mean to complain about the switch from DISC to FSC. In fact, SIA and its members were strong advocates of the change. But it is nonetheless important to note that one consequence of the change was to increase the overall tax burdens of high technology companies while reducing the burdens on other exporters.

The semiconductor industry stands prepared to bear its fair share of federal income taxes. Indeed, the industry believes -- as the Joint Committee's analysis bears out -- that it already is paying more than its fair share. The industry is not here seeking special treatment or requesting that it be excluded from any generally applicable tax increase that may prove necessary. Rather, by requesting a permanent extension of the R&D credit, the industry seeks the continuation of an effective tax incentive and to avoid any exacerbation of the substantial disparity that already exists between its tax burden and the tax burden of U.S. industries in general.

In order to produce effective results, highly technical research and development programs must be well planned, and the more important of such programs necessarily extend over a number of years. This is particularly true for the high technology industries, including the semiconductor industry. Thus, we believe that the need for enactment of legislation making the R&D credit permanent is immediate.

CONCLUSION

We in the U.S. semiconductor industry strongly believe that the R&D tax credit has been a valuable incentive for companies to engage in long-term, risky, and expensive R&D endeavors. Equally importantly the credit has been an efficient and effective means of achieving a tax reduction for the high technology companies in general and the semiconductor industry in particular, so that our effective tax rate is somewhat closer to that of the U.S. corporate community generally. The U.S. semiconductor industry is continually searching for capital at a cost that will enable the industry to finance its costly R&D activities in a way that preserves its competitiveness in a world market of highly-subsidized foreign competitors. The R&D credit helps fill an important gap in that financing.

It is of crucial importance to the industry that Congress take action now to make the R&D credit a permanent part of our federal tax law. The U.S. semiconductor industry's greatest competitive challenges in world markets lie in the next few years. As an industry, we have confidence in our capacity to confront this competitive challenge, but our best efforts will not be successful without the favorable environment which the R&D credit goes a long way to create.

Motorola, Inc.
Responses to Questions by Subcommittee on Oversight Committee on Ways and Means

1. Q. Whether your firm and/or association members claimed the research tax credit. If so,

   (a) for what year(s), and

   (b) in what amount(s)

   A. Motorola claimed the following credits:

Year	Credit Claimed
1981	$ 6.54 mil.
1982	10.78 mil.
1983	16.64 mil.

2. Q. The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

   A. Motorola engages in a broad spectrum of research activities. While we do not keep records that would allow us to readily break down expenditures in the way requested, based on an analysis of certain departments within our several businesses, we estimate that more than 50% of the total expenditures claimed were in the area of basic research and development of new products.

3. Q. The final product or process to be affected or created.

   A. The number of new products are too numerous to be totally listed here but they range from the recently introduced cellular radiotelephone ($100 million spent in development), a range of electronic engine controls for a growing worldwide automobile industry, a broad range of new Bipolar IC and MOS integrated circuits including the recently introduced 32-bit 68020 Micropressor ($50 million development cost), the 256K dynamic random access memory device and several communications products aimed at the Japanese market. Many of these products are already contributing to a growing export volume.

4. Q. If the credit had not been available,

   (a) the specific product or experimental activity that would not have been undertaken,

   (b) whether such activities would have been deferred to the future or never undertaken, and

   (c) the resulting amount of reduction in overall research spending.

   A. (See below - 5A)

5. Q. The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

   A. Questions 4 and 5 cannot be answered specifically as the majority of our R&D expenditures are fungible and of a continuous nature. The fact is, our expenditures increased in 1981, the first year of the credit, to 5.6% of sales from 3.9% of sales in 1980. We continued to spend at that accelerated pace in 1982 and 1983. We attribute this significant increase directly to an awareness by our operating and research personnel of the tax benefit available through the credit.

6. Q. The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

   A. Almost without exception, the expenditures claimed for the tax credit are included in the research expenditures reported to the SEC. The amounts reported to the SEC in fact exceed the amounts used for tax credit purposes, primarily due to depreciation on R&E equipment (non-includable for tax credit purposes).

7. Q. If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

   A. As stated to the Subcommittee at the hearings, most of our research and development involves time periods exceeding one year and in the case of the cellular radiotelephone equipment, development took place over ten years. If in fact the credit is to act as an incentive to R&D efforts, then it must be perceived as "long-term" and allow companies to make it a part of their long-term strategic product development budgets.

8. Q. If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

A. We believe narrowing the definition would be detrimental to the whole philosophy of the credit. At Motorola it is not possible to segregate basic and applied research from development of the final products. Motorola is a high technology company. Our definition of technology is the application of science to develop products that serve humanity. Science alone is not technology. Products alone are not technology. Technology contributes to society and a strong U.S. industrial base only when applied science results in successful, profitable products.

R+E Record

October 30, 1984

Mr. William A. Kirk, Jr.
Professional Assistant
House Committee on Ways and Means
1101 Longworth House Office Building
Washington, D. C. 20515

Dear Bill:

Enclosed is a supplemental submission for inclusion in your record of the August 2 and 3, 1984 Ways and Means Oversight Subcommittee hearings on the R&D tax credit. The submission was prepared jointly by the American Electronics Association, the Computer and Business Equipment Manufacturers Association, the Scientific Apparatus Makers Association, and the Semiconductor Industry Association. We appreciate your cooperation in allowing us to submit this document.

The Subcommittee hearings were in our view very important and useful in developing a substantial body of factual material and expert opinion on the effectiveness of the credit to date. Given this wealth of information and opinion, we believed it worthwhile to put together in a single document a comprehensive industry analysis of all the issues relating to the credit which were raised and debated at the hearing. This submission is intended to be such a document.

We hope you find the submission helpful as you continue your review of the record relating to the credit. We also hope it will be useful to others in the Congress who will no doubt be giving serious consideration to legislation to extend the credit in the next Congress.

Sincerely,

Kenneth C O Hagerty
Kenneth C. O. Hagerty
American Electronics Association

Ted Heydinger
Ted A. Heydinger
Computer and Business Equipment
Manufacturers Association

Michael J. Duff
Scientific Apparatus Makers
Association

Warren E. Davis
Warren E. Davis
Semiconductor Industry Association

EXECUTIVE SUMMARY

I. INTRODUCTION: THE FUNDAMENTAL IMPORTANCE OF INDUSTRIAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES

Technological leadership is one of this Nation's most important resources. However, our leadership in science and technology is now under serious challenge from competitors throughout the world. United States companies have lost world market share in eight out of ten high technology industries over the past fifteen years. The increasing level of competition faced by U.S. high technology companies and industries requires that U.S. policymakers give serious consideration to the impact of existing and proposed governmental policies on the activity which underlies all technological change: research and development. No longer can the simple assumption be made that U.S. companies will in their own interest invest sufficient funds in R&D to ensure continued U.S. technological leadership.

This paper analyzes the reasons why governmental policies to encourage the expansion of industrial R&D in the United States are both appropriate and necessary. It discusses why the tax system is the best suited mechanism to implement these governmental policies. Finally, the paper analyzes the past and potential impact of the current R&D tax credit as a centerpiece among governmental policies to encourage R&D and concludes that the credit should be extended at the earliest possible date.

II. THE NECESSITY FOR GOVERNMENTAL INCENTIVES FOR U.S. RESEARCH AND DEVELOPMENT ACTIVITIES

While there clearly are significant competitive reasons for U.S. high technology companies to make substantial investments in R&D, additional incentives provided by government are both necessary and appropriate for several important reasons.

First, it is well established that private investors are unable to capture as a financial return all of the public economic benefits of any successful R&D project. An individual company will be unable to capture as a salable product the public benefit of advancement in the state of knowledge generally which arises from its research and development efforts. Patents, copyrights and other legal devices cannot, for example, prevent competitors from coupling reverse engineering with their own research to develop comparable or improved products by building on the foundation of their competitors' R&D efforts. Further, a particular company performing R&D will be unable to capture the benefits which arise in the form of economic resource savings that accrue to users of an innovation. Only through government R&D incentives can the market characteristics that lead to a shortfall in the level of private R&D investments be overcome and R&D spending expanded to a level which more closely reflects the full economic benefit derived from R&D by the economy as a whole.

Second, foreign governments recognize the need for governmental policies to encourage expanded R&D activities. Generous tax incentives are provided by the governments of many of our strongest foreign competitors. These incentives significantly lower their after-tax cost of R&D. In addition to tax incentives, foreign competitors often receive special government nurturing in the form of protected markets for emerging technologies, subsidized government loans, a panoply of special allowances and export subsidies, and government sponsorship of collaborative research efforts in key technological fields. Without comparable incentives U.S. companies can be adversely affected, and serious competitive disadvantages will result.

Finally, U.S. high technology companies are particularly constrained from expanding R&D by competing needs for their limited financial resources, by the high cost of such capital to these companies relative to that of foreign competitors, and by strong market pressures to focus on short-term earnings results. All of these factors lead U.S. companies to invest lesser amounts in R&D than is beneficial to the economy as a whole.

III. THE DESIRABILITY OF TAX-BASED R&D INCENTIVES

The problem of U.S. companies investing less in R&D than is beneficial from the perspective of the U.S. economy can be addressed by governmental policies in either of two ways. First, the Government can attempt to isolate the causes of the problem and restore, as nearly as possible, an efficient market process. Alternatively, the Government can take the matter directly into its own hands, supplant the market, and directly determine the outputs that it desires, through such vehicles as direct expenditures, loans and grants.

However, the use of a tax incentive mechanism has a great advantage over direct governmental intervention because such an incentive promotes market solutions based on decisions by those individuals most familiar with market needs and innovative responses. Tax incentives are the only practical way for the Government to encourage expanded industrial R&D without impeding the decisionmaking flexibility which must be kept intact to maintain U.S. corporate competitiveness in worldwide markets.

IV. EFFECTIVENESS OF THE CURRENT R&D TAX CREDIT AS AN INCENTIVE

A. THE R&D CREDIT AND LEVELS OF R&D SPENDING

The R&D credit was enacted in mid-1981. It was not fully phased in until 1983 and has been scheduled to expire at the end of 1985. Moreover, from late 1981 through 1982 this country faced the most severe economic downturn since the 1930's. This relatively brief and unusual period of time, combined with the long-run nature of the R&D planning process, makes it unlikely that the true impact of the R&D credit can now be measured precisely from changes in aggregate levels of R&D spending over the period. Nonetheless, a careful review and analysis of the data available to date suggests the positive conclusion that the credit may well have been a significant factor in increasing R&D spending since 1980.

The first indication that the R&D credit may have significantly influenced R&D spending levels is the fact that R&D spending remained strong during the 1981-82 economic recession. Total corporate R&D spending steadily increased from $30.5 billion in 1980 to $35.4 billion in 1981 and $39.2 billion in 1983. By contrast, during this same period corporate investment in plant and equipment dropped considerably. Thus, at a time when business expenditures of all types were being closely scrutinized by management struggling against weak markets, high interest rates, and reduced profit and cash flow levels, R&D budgets were substantially strengthened, both in absolute terms and relative to the budgets of other corporate departments.

This growth in R&D during the 1981-82 recession differs significantly from past recessionary periods in which R&D spending levels have consistently fallen. Indeed, when industrial R&D spending generally over the past twenty years is correlated to changes in gross national product, the data demonstrate that R&D spending levels prior to 1980 were well-explained by the strength or weakness of the economy. However, data for the years following 1980 indicate that R&D spending has been significantly higher than would be predicted on the basis of aggregate economic growth. For example, by 1984 R&D spending exceeds levels which would be predicted by economic growth by as much as $7.7 billion per year. These data are consistent with the theory that the R&D credit has been an effective incentive.

The example of the electronics industry reinforces this conclusion. In the electronics industry R&D grew rapidly both in absolute terms and as a percentage of sales during the 1981-1983 period. For example, R&D outlays by the computer industry rose 19.5 percent in 1983 to $5.9 billion, continuing a pattern of significant increases since 1981. The semiconductor industry increased its R&D spending by 21.6 percent in 1983 to $734.8 million. The telecommunications industry R&D spending grew by 31 percent to $1.3 billion. Moreover, a survey of 25 randomly-selected computer companies, all of which experienced rapid sales revenue growth, indicates that 22 of the companies have increased their R&D spending as a percentage of sales revenues since the enactment of the R&D credit.

In short, while the data available to date is preliminary and cannot conclusively prove that the R&D credit caused the increases in R&D spending, the results shown thus far are precisely those that would be expected from an effective incentive.

B. Why the R&D Credit Does Cause Increases in R&D Spending

An important reason for the continued strength in R&D spending during the tight financial squeeze brought about by the recent severe recession, according to a National Science Foundation survey and the experience of AEA, CBEMA, SAMA, and SIA members, is that corporate R&D personnel were able to argue persuasively for R&D spending increases because of the more favorable tax treatment R&D projects receive under the credit. During the present period of strong economic growth, the R&D credit continues to provide strong leverage to research departments in the corporate budget decisionmaking.

The R&D credit provides such strong leverage because it directly addresses the corporate budgetary bias toward cutting into long-term programs in favor of the short term. While R&D expenses, unlike investments in plant and equipment, directly reduce corporate pre-tax earnings in the year in which they are incurred, the R&D tax credit provides a corresponding direct benefit to the company's earnings in the year of the increased R&D expenditure. Because of this direct benefit, a company can spend substantially more on R&D with a smaller financial statement impact than otherwise would be possible.

For example, if prior to the enactment of the credit a company spent an additional $10 million on R&D projects, the increased expenditure would decrease after-tax earnings by $5.4 million. By contrast, upon application of the credit (assuming the additional $10 million R&D expenditures are qualified and incremental), the after-tax financial statement impact of the increase in R&D is reduced to approximately $2.9 million.

Some in the academic community have criticized the current structure of the R&D credit on the ground that, under a time value of money analysis, the effective rate of the credit is much lower than the 25 percent statutory rate for those taxpayers whose R&D expenditures are growing on a regular basis because increases in R&D spending in the current taxable year are included in the company's base period against which the incremental R&D spending is measured for credit purposes for each of the next three years. The principal problem with this analysis is not that it is theoretically incorrect but that it is simply irrelevant -- it does not reflect the manner in which real world corporate decisionmaking actually occurs. Corporate budget decisions are based on calculations of costs and income as determined for financial reporting purposes. For these purposes, the R&D credit is properly accounted for as a reduction in full of income taxes in the period in which the credit is received without regard to the potential impact of the credit in future years

V. TAX CREDIT FOR CORPORATE SUPPORT OF UNIVERSITY BASIC RESEARCH

The long-run future growth of U.S. high technology industries is dependent in large part on basic research advances in the fields of engineering and the physical sciences. However, U.S. companies have traditionally undertaken only small amounts of basic research because such research by definition has no commercial application. Instead, basic research has been undertaken primarily in our Nation's universities.

The current R&D tax credit applies to corporate funding of university basic research in essentially the same manner as to other corporate research. The experience to date with this provision demonstrates that industry will respond to a tax incentive for funding university basic research. However, great potential exists for an even broader expansion of such funding if the present tax incentive were enhanced by establishing a differentially large tax incentive for corporate funding of university basic research. This incentive could take the form, for example, of a flat rate 25 percent university basic research credit. Such a credit was approved by the Ways and Means Committee in 1981. AEA, CBEMA, SAMA and SIA strongly recommend that legislation extending the R&D credit beyond 1985 include such a provision to expand corporate funding of university basic research.

VI. STRUCTURAL CRITICISMS OF THE R&D CREDIT AND PROPOSALS FOR CHANGE

Several criticisms of the current structure of the R&D credit relate to the fact that the credit only applies to increases in R&D over prior year levels. This feature, for example, eliminates any benefit from the credit for companies with declining R&D. However, relatively few taxpayers are in this category, and changes in the credit to address this concern could cause substantial new problems. AEA, CBEMA, SAMA and SIA continue to support the congressional policy decision to apply the credit only to increases in company R&D to moderate the revenue loss while preserving the effectiveness of the credit incentive for most if not all taxpayers.

Some have asserted that the credit is a questionable incentive because of its limited utility to companies with no tax liability. However, now that the recession has ended and a period of robust growth has begun, the number of corporate taxpayers without tax liability should diminish substantially. Moreover, this concern is equally applicable to all deductions and credits which cannot be used because the taxpayer lacks liability. Finally, the R&D credit provisions do permit a generous carryover of unused credits to other years.

Some have claimed that in 1981 firms that claimed the R&D credit may have interpreted the definition of qualified research to embrace activities that were not truly industrial

R&D. However, the GAO has noted the difficulty faced by firms in reconstructing prior year (*i.e.*, 1980) accounting records for base years in which there had been no particular reason to segregate those R&D costs that thereafter would become eligible for the subsequently enacted credit. For years after 1981 the incremental feature of the credit provides a self-policing mechanism which makes any such overstatement of qualified R&D activities likely a transitory initial phenomenon. Finally, AEA, CBEMA, SAMA and SIA share Treasury's view that the tightened, more precise definition of qualified research for credit purposes that was included in the Senate-passed R&D legislation generally resolves the definitional difficulties that have arisen under the credit's present structure. This proposed definition limits the category of activities eligible for the credit in several significant ways.

VII. THE R&D CREDIT AND HIGH TECHNOLOGY TAX BURDENS

Even with the enactment of the R&D credit, recent studies by the Congressional Joint Committee on Taxation, the publication *Tax Notes*, and industry clearly demonstrate that the high technology industries generally, and the electronics industry in particular, bear corporate tax burdens that are disproportionately high relative to all U.S. industries. Average effective tax rates for U.S. electronics companies range from 50 to 60 percent higher than the average effective tax rates of U.S. companies generally. If the R&D credit had not been enacted, the effective tax rates in the high technology electronics industry would have been 10 to 20 percent higher than their already disproportionately high levels.

Thus, by requesting extension of the R&D credit, the industry merely seeks to continue an effective tax incentive and to avoid any exacerbation of the substantial disparity that already exists between its tax burden and the tax burden of U.S. industries in general.

VIII. CONCLUSION: AN EXTENSION OF THE CREDIT IS NEEDED NOW

AEA, CBEMA, SAMA and SIA strongly believe that the evidence which thus far has been developed leads to the conclusion that the credit has been a sufficiently effective incentive to warrant its extension for a substantial period of time. The problem now is that the temporary nature of the R&D credit is distorting current R&D investment decisions. If the tax incentive embodied in the R&D credit disappears, or if continuation of the credit seems problematic, a company's assessment of the financial risk will inevitably become more adverse and could lead to reduced funding or termination of some projects. Having enacted the R&D credit and thereby encouraged companies to incur R&D risks that they otherwise might have been unwilling to incur, Congress should not reverse this incentive by allowing the credit to lapse.

TABLE OF CONTENTS

Page No.

INTRODUCTION: THE FUNDAMENTAL IMPORTANCE OF INDUSTRIAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES 1

THE NECESSITY OF GOVERNMENTAL INCENTIVES FOR U.S. RESEARCH AND DEVELOPMENT ACTIVITIES 6

The Inherent R&D Shortfall In a Free Market Economy 7

R&D Incentives Established by Foreign Countries 14

Market Pressures That Limit R&D Investment Levels 16

Cost of Capital 16
Impact of R&D Spending on Corporate Earnings 22

THE ADVANTAGES OF TAX-BASED R&D INCENTIVES 25

EFFECTIVENESS OF THE CURRENT R&D TAX CREDIT AS AN INCENTIVE 28

The R&D Credit and Levels of R&D Spending 28

Overall R&D Spending During the 1981-1982 Recession 28

The Experience of the Electronics Industry 35

Eisner Analysis of Aggregate Data 39

Company Surveys of R&D Spending and the Tax Credit 42

How the Tax Credit Increases R&D Spending 46

Actual Company Experience 46

Page No.

Eisner Benefit Theory.................. 49

TAX CREDIT FOR CORPORATE SUPPORT OF UNIVERSITY BASIC RESEARCH..................................... 53

STRUCTURAL CRITICISMS OF THE R&D CREDIT AND PROPOSALS FOR CHANGE.............................. 61

Base Period Determinations.................. 61

Effect on companies with declining R&D.. 61
Alternative bases for incremental credit............................ 63
Fifty percent minimum base period....... 64

Tax Liability Limitation.................... 66

Availability of a Tax Credit and a Deduction for the Same R&D Expenditure........... 68

Concerns Over Possible "Creative Accounting". 70

Definitional Difficulties under Present Law.. 72

Functional Not Stylistic Products and Improvements.................. 74

Financial and Management Products and Processes......................... 76

Experimentation Process................ 78

Clarified Exclusions Relating to Manufacturing Start-up Activities.. 79

Internal Use Software.................. 81

Revenue Impact of Proposed Definition... 83

THE R&D CREDIT AND HIGH TECHNOLOGY TAX BURDENS........ 85

CONCLUSION: AN EXTENSION OF THE CREDIT IS NEEDED NOW. 87

LIST OF CHARTS

Page No.

Table 1 Spending on Company Sponsored R&D: 1979-1983 30

Table 2 R&D as % of Revenue 36

Table 3 Compromise Definition: Impact of Style and Taste Limitations 76

Table 4 Compromise Definition: Impact of Management and Financial Services Limitation 77

Table 5 Overall Impact of Compromise Definition 83, 84

INTRODUCTION: THE FUNDAMENTAL IMPORTANCE OF INDUSTRIAL RESEARCH AND DEVELOPMENT IN THE UNITED STATES

Technological leadership is one of this Nation's most important resources. Technological leadership always has been the foundation for America's high standard of living. We have incorporated technology to make innovative "high tech" products that are competitive in world markets. Beyond the high technology industries the application of technology to the manufacturing processes for other products increases our productivity and helps make those products competitive in world markets, even with a workforce that earns a higher wage than the workers of many foreign competitors.

Technological leadership has meant not only a higher standard of living but also important opportunities for expanded jobs and exports in the United States. In the 1970's employment in high technology industries grew at a 50 percent higher rate than overall U.S. job growth. This growth rate was sufficiently strong that by 1980 high technology industries were the largest source of U.S. exports of manufactured products, accounting for 44 percent of total U.S. manufacturing exports. 1/

1/ "An Assessment of U.S. Competitiveness in High Technology Industries" International Trade Administration, U.S. Department of Commerce, February 1983, pp. 9-10.

However, our leadership in science and technology is being rapidly matched by competitors throughout the world. The supremacy of American technology and the American high technology industries no longer can be taken for granted. According to a report prepared last year for the Cabinet Council on Commerce and Trade, the United States has lost world export market share in eight out of ten high technology industries over the past fifteen years. 2/ In industries ranging from aircraft and engines to industrial chemicals, scientific and medical instruments and electrical equipment and components, the predominance of U.S. high technology companies is being challenged.

The example of the semiconductor industry illustrates this trend. The worldwide market for semiconductor products continues to grow both in sheer volume and in diversity of applications. However, in recent years Japanese companies have significantly improved their market share at the direct expense of U.S. industry. 3/ On a worldwide basis, the United States still is the leader with a 54 percent overall market share, but

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2/ Id. pp. 9-10.

3/ Id. pp. 9-10, 14; see also Written Statement of John T. Hickey, Executive Vice President and Chief Financial Officer, Motorola, Inc., on behalf of the Semiconductor Industry Association (SIA), before the Subcommittee on Oversight of the House Ways and Means Committee, August 3, 1984, at 8.

within the past year Japan's share has increased by 5 percentage points to 38 percent. In 1983, Japanese sales in the world market increased by 35 percent over 1982, as compared with a 20 percent increase by U.S. companies. Japanese semiconductor companies increased their share of the U.S. market by 30 percent to a total U.S. market share of 30 percent. By contrast, the U.S. share of Japan's semiconductor market dropped from 10 percent to 9 percent.

The semiconductor example illustrates how the rapid pace of technological change has an immediate and fundamental impact on the competitiveness of U.S. industry. For high technology companies generally, a very substantial portion of 1984 sales are of products that were not even in existence just a few years ago. As John Young, Chairman of Hewlett-Packard Company, testified before the Subcommittee, 4/ more than two-thirds of 1983 orders at Hewlett-Packard came from products introduced during the previous four years, and more than one-half of 1983 orders were for products introduced since the enactment of the R&D credit in 1981.

4/ Written Statement of John A. Young, President and Chief Executive Officer, Hewlett-Packard Company, on behalf of the Computer and Business Equipment Manufacturers Association (CBEMA), Before the Subcommittee on Oversight of the House Committee on Ways and Means, August 3, 1984, at 4.

Today's technology not only changes rapidly, but is geographically mobile as well. Industrializing nations such as Taiwan and Korea have access to state-of-the-art technology from both the United States and Japan and can rapidly transform that technology into marketable products. A technology transfer process that formerly took years now takes only months or weeks. Moreover, the rate of development of new technology is increasing, and the life cycle of products is being substantially reduced.

The rapid spread of technology to foreign competitors can force U.S. companies into a particularly difficult international competitive position over the long run. Once foreign technology becomes sufficient to generate competitive products which reduce the market share of U.S. companies, expanded revenues from worldwide sales are earned by foreign competitors at the direct expense of U.S. companies. These expanded revenues can and will be used for expanded R&D funding by the foreign competitors also at the direct expense of U.S. company R&D. Thus, any failure in the growth of U.S. R&D can lead to a downward spiral of declining worldwide product sales and further declining R&D over the long run.

The rapid pace of technological change, the importance of U.S. technology to our economy, and the increasing level of competition faced by U.S. high technology companies require that U.S. policymakers give serious consideration to the impact of existing and proposed economic and tax policies on the activity which underlies all technological change: research and development. No longer can the simple assumption be made that U.S. companies will in their own interests invest sufficient funds in R&D to assure U.S. technological leadership. Instead, the processes which determine industrial R&D levels of investment must be examined, and the importance and impact of specific governmental policies on these processes must be analyzed.

This paper undertakes this examination and analysis, as applied specifically to the R&D tax credit, based largely on the record developed at the August 2 and 3, 1984 Ways and Means Oversight Subcommittee hearings. The paper begins by analyzing the reasons why governmental policies to encourage the expansion of industrial R&D in the United States are both appropriate and necessary to the goals of maintaining technological leadership, economic growth, and a higher standard of living. It goes on to discuss why the tax system is the mechanism best suited to implement these governmental policies. Finally, the paper analyzes the past and potential impact of the current R&D tax credit as the centerpiece among governmental policies to encourage R&D.

THE NECESSITY OF GOVERNMENTAL INCENTIVES FOR U.S. RESEARCH AND DEVELOPMENT ACTIVITIES

While there clearly are significant competitive reasons for U.S. high technology companies to make substantial investments in R&D, additional incentives provided by government are both appropriate and necessary for several important reasons.

First, as is discussed in detail below, it is well established that corporate and other private investors are unable to earn a financial return on R&D investments which captures all of the public economic benefits of any successful R&D project. This inability causes a substantial shortfall in R&D investment from the perspective of the nation's economy as a whole unless governmental R&D incentives are established.

Second, foreign governments recognize the need for, and have established, positive governmental policies to encourage expanded R&D activities. If U.S. research and development efforts are adversely affected by a lack of comparable incentives, a serious competitive disadvantage will result for companies undertaking research in the United States.

Finally, U.S. high technology companies are particularly constrained in the extent to which they can expand R&D by the high cost of capital relative to that of foreign competitors, the extremely risky and long-range character of R&D, and the existence of market pressures to focus on short-term earnings results. In a market environment without governmental incentives, providing sufficient financing for expensive, risky, long-range R&D projects becomes difficult even for the strongest U.S. high technology companies.

The Inherent R&D Shortfall In a Free Market Economy

A decision by an individual company to undertake a particular R&D project clearly is an investment decision. An R&D project requires the current commitment of resources with the expectation of recovering in the future the initial amount invested plus a return on that investment. Such an investment decision obviously requires the weighing of the costs to be borne now against the anticipated benefits to be derived in the future.

Under our free market system corporations and individuals are required to balance the costs of any investment against the potential returns to be earned under the particular circumstances confronting them in a world characterized by continuous adjustment possibilities. 5/ However, as Charles Schultze points out, to be an efficient instrument for society, private markets must be so organized that "the costs and gains [the individuals and firms] confront also reflect, as far as

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5/ Charles Schultze, The Public Use of the Private Interest (Brookings Institution, 1977) 81.

possible, true social costs and gains." 6/ That is, the buyers and sellers must realize all of the benefits and bear all of the costs of any transaction.

It is now well established by economic research that, because of the inherent nature of R&D activities, private investors are unable to capture all of the public and private benefits of an R&D project which arise in such forms as the advancement of the state of knowledge generally, the saving of economic resources by reason of the innovation, and the opportunity for reverse engineering of the new product or process by competitors. 7/ The inability of an individual company to capture all of these benefits of its R&D project arises for several reasons.

First, the individual company will be unable to capture as a salable product the public benefit of the resulting advancement in the state of knowledge generally arising from its research and development efforts. This

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6/ Id. [Emphasis in original].

7/ In addition to an extensive study by Edwin Mansfield and others discussed below, studies supporting this conclusion have been undertaken by Jora Minasian (American Economic Review, May 1969); Zvi Griliches (Kendrick and Vaccara, eds., New Developments in Productivity Measurement and Analysis, (University of Chicago, 1980)); Nester Terleckyj (Effects of R&D on Productivity, National Planning Association, 1974); and F. M. Scherer (Review of Economics and Statistics, November 1982).

knowledge cannot by any legal device be completely protected by the individual company. Patents, copyrights, and other legal means of protection cannot always, for example, effectively prevent company employees from starting their own company and using their knowledge to build other new products. Legal devices cannot also always prevent competitors from coupling reverse engineering with their own research to develop somewhat different or improved products built on the foundation of their competitors' R&D effort. In these and other ways, the transfer of technology moves beyond the scope of any possible protection of the creator -- to the direct benefit of society and the economy as a whole.

The second major category of benefits that an individual company performing R&D is unable to capture takes the form of the economic resource savings accruing to the users of the innovation. The innovation may enable the user to perform more functions or to improve the speed or lower the cost at which existing functions are performed. The resulting resource savings will produce a corresponding increase in output elsewhere in the economy as such resources are shifted to more productive uses.

An important example of this resource saving process is presented by the miniaturization of integrated circuits and other electronics components since the 1950's and 1960's. Thirty years ago a computer capable only of performing basic tasks filled the space of a good-sized room. Years of cumulative R&D efforts have improved technology to the point where researchers are now focusing on the condensing of large computer systems onto an 0.1 square inch chip. This miniaturization of electronic components has opened up enormous opportunities for increases in productivity across the entire economy -- from word processing in offices to robots and process controls on factory floors. Yet, the relatively free flow of technology and the competitiveness of U.S. companies (with other U.S. as well as foreign companies) has meant that the prices of each generation of these electronic components have declined rapidly. In a short period of time after introduction, each generation of components has become sufficiently inexpensive to be incorporated in most potential use applications at a modest price. The benefits of the underlying R&D are captured in large part by the users of the components and not their manufacturers.

In an important study involving a broad range of industrial innovations, Professor Edwin Mansfield and others have sought to quantify, as well as identify, the impact of the various factors determining the returns on R&D and to compare the rate of return to the economy as a whole and to the particular company from specific R&D projects. 8/ The concept of overall economic (or social) rate of return, as used in their study of seventeen industrial innovations, includes the return to the company performing the R&D, the return to competitors appropriating benefits of the R&D project through reverse engineering and subsequent R&D, and the return to the users of the innovation and others in the economy in the form of resource savings.

The Mansfield study concluded first that the overall economic rate of return from investments in R&D activities producing industrial innovations is very high. For the seventeen innovations studied, the median estimated overall rate of return was approximately 56 percent. Second, the private rates of return from the investments in these innovations captured by the investing companies were much lower than the overall rates of return. The median pre-tax private rate of return for the innovations studied was approximately 25 percent. 9/

8/ See Mansfield, Rapoport, Romeo, Villani, Wagner, and Husic, The Production and Application of New Industrial Technology, New York: Norton (1977) 144-166.

9/ Mansfield, et al. note that the extreme riskiness of the R&D process is demonstrated by the tremendous variation among the private rates of return for the seventeen innovations studied. For six of these innovations, the pre-tax private

[Footnote continued]

Among the seventeen innovations, thirteen produced estimated overall economic returns in excess of the private returns accruing to the innovators. For about 30 percent of the innovations studied, the private rate of return was so low that no firm, with the advantage of hindsight, would have invested in the innovation, even though the overall economic rate of return from the innovation was so high that, from the perspective of society as a whole, the investment in the innovation was well worthwhile. 10/ Moreover, the study found that the existence of a gap between the overall rate of return and the private rate of return in R&D investments was particularly prevalent in industries, such as the high technology electronics industry, which are highly competitive, experience tremendous rates of innovation and technological progress, and are subject to reverse engineering and "inventing around" a competitor's patents and copyrights.

This gap between the overall economy and private company rates of return from R&D projects reflects market characteristics that will cause private investment in R&D to

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9/ [Footnote continued]

rate of return was less than ten percent (including several unsuccessful projects for which the return was close to zero). For five of the innovations, the private return was more than forty percent. Id., at 166.

10/ Id., at 165-166.

fall short of optimal levels from the perspective of society as a whole. As Professor Cordes pointed out in his written testimony before the Subcommittee: 11/

> Even if capital markets are functioning well -- and indeed, precisely because they are functioning well -- insufficient resources may be devoted to innovations if it is difficult to appropriate all of the economic benefits of the innovation. The potential problem that arises in such cases is that even though the potential benefits to society may exceed the costs of innovation, the firm may not be able to translate enough of those benefits into its own profits to justify the necessary investment.

If the gap between overall and private returns on R&D is to be closed, private investments in R&D must be encouraged through governmental incentives. Such government incentives in essence can represent an investment by the government in R&D to produce those benefits which are in fact derived by the overall economy from the innovator's R&D project but which cannot be captured by the private investor. Only with the existence of government R&D incentives can private R&D spending be expanded to a level that more closely reflects the full economic benefit derived from that R&D by the economy as a whole.

11/ Joseph J. Cordes, Department of Economics, The George Washington University, Statement to the House Ways and Means Committee on the R&D Tax Credit, at 4.

R&D Incentives Established by Foreign Countries

Wholly apart from the R&D shortfall that arises from an inability to capture all R&D economic benefits, U.S. tax incentives are necessary to enable U.S. industries to remain competitive with foreign industries in the development of new products and processes by counterbalancing the R&D and other incentives provided by the home governments of many foreign competitors. Because most companies currently perform the bulk of their R&D in their home countries, the generous R&D incentives provided by many foreign governments significantly lower the after-tax cost of R&D conducted by foreign competitors of U.S. companies. For example, countries such as Canada, Japan, West Germany, Mexico, Spain, France, and Ireland have adopted tax credits to spur R&D activities. To understand the magnitude of the tax and various direct incentives in more detail, a country-by-country review is required. Such a review is set forth in Appendix A to this paper.

Beyond these specific R&D incentives, the governments of many foreign competitors have targeted specific industries -- particularly high technology industries -- for special nurturing. Support for these industries may take the form of protected markets for emerging technologies, subsidized government loans, a panoply of special tax credits, allowances, and exclusions, export subsidies, antitrust exemptions, and government sponsorship of collaborative research efforts in key technological fields. For example, in the area of collaborative research, the Japanese Ministry of International Trade and Industry has initiated and funded projects to establish the "fifth generation" of computers, robotics, software systems, and very large scale integrated circuit technologies.

The success of projects such as these, plus the existence of generous tax and nontax incentives for R&D in most major competitive countries, threatens U.S. technological leadership. As is discussed in more detail below, R&D investments must generally be funded out of current corporate revenues. If governmentally-assisted foreign R&D helps foreign competitors create technologically advanced products, those products will generate increased revenues for the foreign competitors, at the expense of revenues of U.S. companies. Those increases in foreign revenues will in turn fund further increases in foreign R&D and revenues, at the further expense of U.S. R&D and revenues.

Thus, the governments of the foreign competitors of the U.S. high technology industries have made R&D a strongly tax-favored activity, enabling these foreing competitors to substantially reduce the after-tax cost of conducting R&D. Accordingly, if the U.S. R&D tax credit is not extended, U.S. industries will be at a serious tax disadvantage with respect to R&D activities in intensely competitive international markets. 12/

Market Pressures That Limit R&D Investment Levels

While a fundamental cause of the historical shortfall in U.S. research and development investment levels is the inability of private investors to capture all the benefits of their investments, various market pressures tend to increase this shortfall. These market pressures relate to such factors as the cost of capital in the United States for risky R&D investments, the impact of R&D investments on short-term corporate earnings, and the competing alternatives for investments of company capital.

Cost of Capital

The tremendous rate of technological change and the increase in technological complexity presently occurring in world high technology industries dramatically increase the requirements of many U.S. high technology companies for new capital to finance not only R&D investments but also investments in equipment and facilities to manufacture new products ultimately developed. For example, the U.S.

12/ Accelerated depreciation under ACRS, as amended by the 1982 and 1984 tax acts, provides no true benefit to the industry because of the already short-lived character of its R&D equipment.

semiconductor industry's average company investment in R&D is over 8 percent of sales revenues -- the highest of any industry listed in the Business Week R&D survey -- as compared with an overall U.S. industry average of less than 3 percent of sales. Some companies in the industry invest as much as 14 to 16 percent of sales in R&D. Further, the needs for increased productivity to remain competitive in the world semiconductor market requires new investments in plant and equipment by U.S. industry which average between 20 and 25 percent of sales, more than twice the average of other industries. In this environment, one of the most critical challenges facing U.S. high technology companies today -- as exemplified by the U.S. semiconductor industry -- is obtaining the necessary amounts of capital at realistic costs.

Because of the manner in which most U.S. high technology companies must raise capital, a crucial link exists between the industry's ability to obtain capital and the effective tax rates borne by the companies. The bulk of the capital raised by high technology companies comes from equity investments -- the reinvestment of retained earnings and new common stock issues. 13/ Because of the level of risk

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13/ Written Statement of John T. Hickey, Executive Vice President and Chief Financial Officer, Motorola, Inc., on

[Footnote continued]

involved, substantial debt financing of corporate investments is generally not feasible for most high technology companies. Moreover, in most economic periods since the late 1960's, new common stock issues have proved to be a very expensive source of funds. 14/ Consequently, high technology companies pay little or no dividends, and plow the great bulk of their after-tax earnings back into business operations, including substantial investments in R&D. Thus, high technology companies, more than companies in other industries, must look first to retained earnings for new investment capital. To the extent that these companies bear comparatively high U.S. corporate tax burdens, this major source of capital is disproportionately depleted, and more expensive sources must be sought.

Even with the enactment of the R&D credit, recent studies by the Congressional Joint Committee on Taxation, 15/

13/ [Footnote continued]

behalf of the Semiconductor Industry Association (SIA), before the Subcommittee on Oversight of the House Ways and Means Committee, August 3, 1984, at 8.

14/ Chase Financial Policy, U.S. and Japanese Semiconductor Industries: A Financial Comparison, June 9, 1980; Dr. George N. Hatsopoulos, High Cost of Capital: Handicap of American Industry, American Business Conference, April 26, 1983.

15/ Staff of the Joint Committee on Taxation, Study of 1982 Effective Tax Rates of Selected Large U.S. Corporations, November 14, 1983.

by the publication Tax Notes, 16/ and by industry clearly demonstrate that the U.S. high technology electronics industry bears a corporate tax burden that is high relative to U.S. industry generally. The Joint Committee analysis indicates, for example, that average effective tax rates on U.S. income for U.S. electronics companies in 1981 were 50 percent higher than those of U.S. companies generally, with such disparity growing in 1982 to as much as 60 percent. A study by twenty companies from the U.S. high technology electronics industry established that if the R&D credit had not been enacted, the effective tax rates in the high technology electronics industry would have been 10 to 20 percent higher than their already disproportionately high levels. 17/ Allowing the R&D credit to lapse would exacerbate this disparity between high technology industries and U.S. companies and would further diminish the capital available to U.S. high technology companies to invest in R&D.

16/ "Effective Corporate Tax Rates in 1981," a special supplement prepared by the editors of Tax Notes, April 1982.

17/ "High Technology Tax Policies for the 1980's: A Report of the Ad Hoc Electronics Tax Group" to American Electronics Association, Computer and Business Equipment Manufacturers Association, Electronic Industries Association, Scientific Apparatus Makers Association, and Semiconductor Industry Association (January 1984), 16-23.

This problem of capital cost and availability is not shared by many of America's competitors in world high technology markets whose cost of capital often is subsidized by a panoply of favorable government tax measures. An excellent example is the cost of capital differential in the world semiconductor market between the United States and its major foreign competitor in the market, Japan. Recent studies in 1980 by Chase Financial Policy, an affiliate of Chase Manhattan Bank, 18/ and in 1982 by Paine Webber Mitchell Hutchins, Inc. 19/ clearly establish that the cost of capital for a typical U.S. semiconductor company is dramatically higher than for its typical Japanese competitor, in part because of a generous series of Japanese government subsidies. The Paine Webber study concluded: "[T]he average Japanese semiconductor company has a cost of capital that is at least 35% lower than its average equity-dominated U.S. competitor. * * * The lower cost of Japanese companies' capital means that the required rate of return on that capital is lower. Other things being equal, the Japanese company requires less profit than the

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18/ Chase Financial Policy, U.S. and Japanese Semiconductor Industries: A Financial Comparison, supra.

19/ "U.S. and Japanese Competition in the Semiconductor Industry" Paine Webber Mitchell Hutchins, Inc. (December 20, 1982).

higher cost U.S. companies and can therefore price products lower."

This tremendous advantage enjoyed by the Japanese competition in the cost of capital has permitted the Japanese semiconductor industry to achieve more rapid rates of investment in costly semiconductor R&D, steady increases in its rate of capital investment generally, and, as has been previously discussed, dramatic increases in market share. Again using the semiconductor industry as an example, during the period from 1977 to 1983, R&D expenditures by the Japanese semiconductor industry have been in the range of 13 to 16 percent of sales, as compared with 8 to 12 percent of sales by U.S. competitors. Capital investment as a percentage of sales by the Japanese semiconductor industry also far surpassed U.S. companies, with 30 percent of sales invested by Japanese firms as compared to 20 percent of sales by U.S. merchant semiconductor firms. This significant Japanese differential in R&D and capital investment has helped the Japanese semiconductor industry to increase its share of the world market at a much faster rate than the U.S. industry.

In short, the capacity of U.S. high technology companies to fund extensive R&D efforts depends upon their ability to obtain capital at a cost that is competitive with that faced by foreign competitors. Because most U.S. high technology companies can only raise capital first through retained earnings (at a reasonable cost) and then through new equity issues (which are relatively expensive), the cost of such capital is adversely affected by the relatively high effective U.S. corporate tax rates imposed on high technology companies.

Impact of R&D Spending on Corporate Earnings

The R&D process is inherently risky and necessarily has a longe-range focus. The tremendous degree of risk and uncertainty that characterizes R&D activity in various high technology industries substantially impedes the efficiency with which the market system operates with respect to that activity. As Charles Schultze has pointed out, "[T]here are occasions when uncertainties about the future are so great, and the investment requirements so large, that even sizable and well-established business firms may be unwilling to undertake ventures that, from society's standpoint, are desirable." 20/ The proper solution in such a case, Schultze concludes, is the use by government of an incentive that overcomes this market encourages investment by entrepreneurs because "[s]ociety as a whole, through government, can pool the risks from many

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20/ Schultze, The Public Use of the Private Interest, *supra*, at 41.

different investments; losses from a few bad guesses can be averaged in with the gains from others." 21/

The corporate bias against long-term, risky investments in R&D is reinforced by the fact that every additional dollar spent on R&D means a dollar less in pre-tax corporate earnings per share in that same year, since R&D costs are generally expensed in the year incurred for financial accounting purposes. While this treatment is entirely proper, it does place R&D at a disadvantage as against investments, for example, in plant and equipment, the cost of which may be spread out over any period from 5 to 40 years for financial accounting purposes.

Most high technology companies always will have more potentially productive R&D projects than can be properly financed at any one time. Management faces the very difficult task of allocating limited budgetary resources among R&D projects seeking to develop new products, investment in plant and equipment to expand production of existing products, R&D projects attempting to modernize production processes, more vigorous marketing efforts, and a host of other competing needs. Faced with these alternatives, the long-run nature of most R&D projects, their riskiness of commercial success, and their short-run impact on corporate earnings, it is not surprising that U.S. corporate investments in R&D would tend to fall short of the levels needed to maintain U.S. technological leadership.

21/ Id.

THE ADVANTAGES OF TAX-BASED R&D INCENTIVES

Because of the gap between the overall economic benefits and the private benefits in undertaking R&D, the existence of major incentives available to foreign competitors, and the competing needs for the scarce capital of U.S. corporations, the free market if left alone will produce a less than optimal, or even competitively acceptable, level of industrial R&D in the United States from the perspective of both the individual company and the U.S. economy generally. Governmental policies can address this R&D shortfall through either of two ways. First, the Government can attempt to isolate its causes and influence the market processes to enhance the market's efficiency. Alternatively, Government can take the matter directly into its own hands, replace the market, and directly determine the R&D investments it desires, though direct expenditures, grants and subsidy loans, which are currently included under the rubric of "industrial policies." 22/

22/ See Schultze, Public Use of the Private Interest, supra, 28-30. See also, as an example of the industrial policy approach, H.R. 4360, the "Industrial Competitiveness Act," introduced in the 98th Congress by Congressman LaFalce and others. This approach was also embraced by Professor Eisner in his testimony before the Subcommittee (see Prepared Statement of Robert Eisner, "The Research and Experimentation Tax Credit," for the Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives, August 2, 1984, at 14).

It is the strongly held view of the associations preparing this paper, and of their collective membership, that the industrial policy approach is fatally flawed. Expanding industrial R&D through Government grants and loans forfeits all of the important strategic advantages of free market arrangements. Centralized and government-directed R&D programs will inevitably miss important market opportunities and will lead to ineffective and inefficient solutions to our vital economic problems. Such programs can tax the ability of the Government beyond its limit to make complex resource allocation decisions. 23/ Grantsmanship rather than technical promise can dominate resource allocations. Given the dramatic technological change experienced by high technology companies and the tremendous rate at which those changes occur, it would be exceedingly difficult even to accumulate the necessary information at a central level to permit direct Government

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23/ For example, the Washington Post recently noted that: "The Pentagon's Strategic Computing Program, widely seen as a response to Japan's highly touted Fifth Generation computer project is rapidly falling behind schedule because of logistical problems and internal squabbling, according to several Defense Department sources. * * * The program already has undergone at least one major reorganization designed in part to minimize personnel disputes * * * [A]gency officials have serious questions about how to measure progress in the program, that the perception of the program by the academic research community is negative, and that it is doubtful that the disparate technologies can be integrated for demonstrable programs in the allotted time." Washington Post, September 5, 1984, F5-6.

intervention. It would be even more difficult to assume that governmental investments would be made on the basis of this information rather than through more politicized processes.

On the other hand, utilizing the tax system to provide incentives for industrial R&D does not replace market decisions, but merely influences the factors which underlie those decisions. The principal advantage of a tax incentive mechanism to encourage R&D spending lies precisely in the ability of such an incentive to affect the manner in which thousands of separate private decisionmakers, who possess the most relevant information and who are best positioned to act, balance the benefits and costs of specific alternatives under the particular circumstances actually confronting them. The areas for research spending are chosen by those most knowledgeable as to the technology and the economics of the market. The innovations that do arise must then surmount the rigorous test of the marketplace, rather than satisfying arbitrary or politically motivated Government criteria.

In short, R&D incentives operating through the tax system promote market solutions based on decisions by those individuals most familiar with market needs and innovative responses. It is the only practical way for the Government to encourage expanded industrial R&D without impeding the decisionmaking flexibility necessary to maintain U.S. competitiveness in world markets.

EFFECTIVENESS OF THE CURRENT R&D TAX CREDIT AS AN INCENTIVE

The R&D Credit and Levels of R&D spending

The R&D credit was enacted in mid-1981. It was not fully phased in until 1983, and regulations for applying the credit were not proposed until that year. From its enactment the credit has been scheduled to expire at the end of 1985. Moreover, in 1981 and 1982 this country faced the most severe downturn in economic activity it has experienced since the 1930's. All of these factors, combined with the long-run nature of the R&D planning process, make it unlikely that the true impact from the R&D credit can now be measured precisely. Nonetheless, a careful review and analysis of the data available to date suggests the positive conclusion that the credit may well have been a significant factor in increasing R&D spending since 1980.

Overall R&D Spending During the 1981-1982 Recession

The most important indication that the credit may have significantly influenced R&D spending levels since 1980 is the fact that R&D spending remained strong in the 1981-1982 economic recession. As is documented below, R&D spending in real terms generally declines during a serious recession. But despite the relatively severe 1981-1982 recession, total corporate R&D spending increased from $30.5 billion in 1980 to

$39.2 billion in 1983. 24/ Aggregate R&D spending, according to the Business Week survey, increased in 1983 alone by almost 10 percent over 1982, providing an increase in real terms of nearly 6 percent. 25/ The real increase in 1982 over 1981 was 5.1 percent. Table 1 breaks down these increases in spending by industry.

24/ See Business Week R&D Scorecard - 1983, July 9, 1984, based on a survey of 800 companies.

25/ These aggregate increases and their unusual nature during a recession were verified on an individual company basis by several witnesses before the Subcommittee (e.g., see Written Statement of Joseph A. Saloom, Senior Vice President, M/A-COM, Inc. for the American Electronics Association, before the Subcommittee on Oversight of the Committee on Ways and Means, August 3, 1984, at 14).

Table 1 .

SPENDING ON COMPANY SPONSORED R&D: 1979-1983
(millions of dollars)

		1979	1980	1981	1982	1983
1	AEROSPACE	1565.0	2045.5	2363.2	2518.1	2575.5
2	APPLIANCES	130.6	168.4	159.7	159.4	191.6
3	AUTOMOTIVE: CARS, TRUCKS	4337.4	4501.6	4545.1	4527.4	4905.7
4	AUTOMOTIVE: PARTS, EQUIP.	258.2	292.5	350.9	367.2	185.5
5	BUILDING MATERIALS	144.8	159.8	175.3	164.6	171.6
6	CHEMICALS	1901.2	2161.1	2635.2	3032.0	3354.9
7	CONGLOMERATES	985.9	1197.3	1280.7	1429.0	1480.2
8	CONTAINERS	110.5	116.9	119.4	102.2	103.4
9	DRUGS	1813.0	2157.5	2450.6	2978.0	3422.4
10	ELECTRICAL	1133.1	1311.6	1487.1	1501.7	1690.1
11	ELECTRONICS	536.9	805.6	841.3	1364.5	1592.4
12	FOOD & BEVERAGE	456.5	520.6	578.1	669.0	656.6
13	FUEL	1131.2	1506.5	2261.1	2357.3	2366.6
14	COMPUTERS	3031.7	3400.6	3845.5	4716.9	5853.2
15	OFFICE EQUIPMENT	448.1	562.1	729.2	769.5	730.2
16	INFO PROC'G: PERIPHERALS	0.0	301.6	344.1	453.8	444.9
17	INFO PROC'G: SOFTWARE, SERV.	0.0	0.0	0.0	0.0	144.7
18	INSTRUMENTS	500.4	591.5	647.5	718.5	894.0
19	LEISURE INDUSTRIES	718.3	799.6	896.1	1024.7	1133.0
20	MACHINERY: FARM, CONST"N	606.4	668.4	726.9	781.6	702.1
21	MACHINERY: TOOLS, IND., MINING	426.7	491.6	494.5	416.5	396.2
22	METALS & MINING	183.8	215.9	245.1	230.5	211.0
23	MISC. MANUFACTURING	901.5	930.1	1166.9	1269.9	1311.0
24	OIL SERVICE & SUPPLY	291.7	470.2	623.6	815.0	790.3
25	PAPER	167.3	271.7	255.9	273.2	300.8
26	PERSONAL & HOME CARE PROD.	406.7	524.5	590.1	711.1	788.7
27	SEMICONDUCTORS	477.0	617.3	713.5	562.5	734.8
28	STEEL	146.2	165.6	179.7	192.1	173.6
29	TELECOMMUNICATIONS	553.3	614.4	878.7	1090.5	1295.7
30	TEXTILES, APPAREL	45.4	50.0	47.8	54.9	75.4
31	TIRE & RUBBER	398.4	413.7	451.2	493.5	517.2
32	TOBACCO	29.7	31.2	22.4	18.8	19.0
	TOTALS	23836.2	28064.9	32106.5	35763.9	39212.3

SOURCE: Business Week R&D Scorecard - July 9, 1984.

By contrast, during the same 1981-1983 period corporate investment in plant and equipment followed the normal recessionary course and dropped considerably. In 1982, business fixed investment (in constant dollars) fell 4.8 percent; and in 1983 such investment was still 3.7 percent below its 1981 level. 26/ In addition, wages and salaries in the private sector during this period rose at only half the rate of increase in R&D spending. Thus, at a time when business expenditures of all types were being closely scrutinized by management struggling against weak markets, high interest rates, reduced profits and reduced cash flow, R&D budgets were substantially increased, both in absolute terms and relative to the budgets of other corporate departments.

This growth in R&D during the 1981-1982 recession differs significantly from past recessionary periods in which R&D spending levels have consistently fallen. This difference can be seen by examining the correlation of R&D spending to changes in the gross national product (GNP) over time. When regression analyses are used to correlate company R&D spending to GNP (both measured in constant 1972 dollars), the results indicate that R&D spending patterns quite closely mirror changes in overall levels of GNP through not only recessions

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26/ See 28th Annual McGraw-Hill Survey of Businesses' Plans for Research and Development Expenditures, 1983-1986.

but all periods of various economic cycles. 27/ However, the correlation between R&D spending and GNP diminishes in the 1980's. The data indicate that R&D spending during the four years through 1984 (estimated) averages at least $1.3 billion in current dollars higher than the levels that would be predicted on the basis of the traditional relationship of R&D to GNP. By 1984 R&D spending exceeds GNP predicted levels by as much as $7.7 billion per year.

The higher than predicted level of R&D spending in the 1980s is consistent with the theory that the R&D credit, rather than merely aggregate economic strength, have had a significant effect on industrial R&D spending since 1980. While this type of analysis cannot conclusively prove the effectiveness of the R&D credit in stimulating R&D spending, these results are precisely those that would be expected from an effective incentive.

The shift of R&D from a declining to a growing percentage of GNP was underway in 1980, before the enactment of the R&D credit. However, it is possible that at least part of this pre-R&D credit shift in spending was due to special factors, including intensive but ultimately temporary increases

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27/ Appendix B sets forth the results of the regression analysis used to correlate R&D and GNP levels. In that analysis, the R-squared is .975, and the other measures of goodness-of-fit are highly significant.

in energy development and conservation research and in research to comply with regulatory requirements. For example, 1979 and 1980 were the years of the second major oil price increase by OPEC. This development resulted in significant but temporary increases in R&D spending by the fuel and oil service industries, particularly on alternative sources of energy. According to a National Science Foundation analysis:

> Nearly a decade of virtually no real growth in R&D funding ended following the oil embargo of 1974 and the recession in early 1975. At that time the Nation's R&D effort began a period of real-term growth that was heavily influenced by the search for solutions to the energy problem. Between 1975 and 1980, national R&D expenditures increased in constant dollars at an average annual rate of 4.5 percent. Over this period, non-Federal R&D support increased at twice the rate as Federal R&D support (6 percent annually versus 3 percent). The increases in non-Federal support were concentrated in industry and resulted mainly from greater emphasis on fossil fuels and energy conservation. * * * In addition, Federal policies concerning regulations and minimum standards also affect industry's R&D spending levels, particularly in areas such as food and drug production, environmental pollution, and public safety. For example industry reported spending $700 million of company funds in 1979 on R&D projects undertaken to meet existing government regulations. By 1981 this total had risen to $2.5 billion.
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> [National Science Foundation, National Patterns of Science and Technology Resources, 1984 (NSF 84-311) at 7, 8. [Emphasis supplied]]

The National Science Foundation data indicate that if energy and regulatory related R&D is ignored, a smaller rise would likely be seen in overall levels of R&D spending in 1979 and 1980, with a more pronounced upward trend beginning in 1981. This analysis is further evidence that the credit in may fact have been a significant incentive beginning soon after its enactment in 1981.

Of course, because of the limited period of time, the phase in of the credit, and the existence of a major recession, no firm conclusions can be drawn from these data. Indeed, during the 1981-1982 recession many companies could not use their R&D credits because they had no U.S. income tax liability; 28/ for some of these companies at least, the credit may not have been a significant incentive. However, now that the recession has ended and the credit has been phased-in and integrated into corporate decisionmaking, the impact of an extended R&D tax credit on aggregate levels of industrial R&D is likely to be substantial.

28/ Statements submitted to the Subcommittee indicate that the number may be as high as 59 percent. See, e.g., Prof. Edwin Mansfield, University of Pennsylvania, "Public Policy Toward Industrial Innovation: An International Study of R&D Tax Credits," (1983) at 13.

The Experience of the Electronics Industry

The potential impact of an extended R&D credit over the long run is perhaps foreshadowed by the experience to date of the electronics industry. Many sectors of the electronics industry were less affected by the recession than was U.S. industry overall, and most companies in the industry had substantial tax liabilities throughout the 1981-83 period. R&D expenditures in the industry grew at unprecedented rates during the period. R&D outlays by the computer industry rose 19.5 percent in 1983 over 1982 to $5.9 billion, continuing a pattern of significant increases since 1981. This 1983 spending by the computer industry represented almost 44 percent of pre-tax profits. Similarly, the semiconductor industry increased its R&D spending by 21.6 percent in 1983 to $734.8 million. The telecommunications industry R&D spending in 1983 grew by 31 percent to $1.3 billion. The instrument industry R&D spending grew at a 11.5 percent rate to $894 million.

Moreover, a survey of 25 randomly-selected computer companies, all of which experienced substantial sales revenue increases since 1980, indicates that 22 of the companies have increased their R&D spending as a percentage of sales revenues since the enactment of the R&D credit:

TABLE 2

R&D as % of Revenue

	Fiscal Year Ending	1980 R&D % of Revenue	1984 R&D % of Revenues
Dysan Corporation	10/31	17.3%	19.8%
Cray Research	12/31	14.5	17.5
Amdahl Corporation	12/31	15.8	14.2
Network Systems	12/31	13.9	13.0
Apollo Computer	12/31	*	12.0
Digital Equipment	6/30	7.9	10.9
Prime Computer	12/31	7.6	10.7
Tandem Computers	9/30	8.1	9.8
IBM Corporation	12/31	5.9	8.6
Data General	9/30	10.0	8.5
Storage Technology	12/31	6.5	7.8
Wang Labs	6/30	6.8	7.6
Apple Computer	9/30	6.2	7.3
Honeywell, Inc.	12/31	6.0	7.2
NBI, Inc.	6/30	7.8	7.2
NCR Corporation	12/31	6.1	7.0
Burroughs Corporation	12/31	5.4	6.0
Altos Computer	6/30	*	6.0
MiniScribe Corporation	12/31	*	5.6
Quantum Corporation	3/31fol.	*	5.4
CPT, Inc.	6/30	3.4	5.1
Convergent Technologies	12/31	*	4.9
Tandon Corporation	9/30	4.2	4.3
TeleVideo Systems	10/31	1.3	3.9
Seagate Technology	6/30	*	3.5

* Start-ups with little or no revenue in the year.

Source: Compustat, Smith-Barney estimates of 1984 R&D as % of revenues.

This pattern of growth in R&D spending as a percentage of sales revenues is shared by other high technology companies who have submitted R&D credit data to the Subcommittee. 29/ For example, Hewlett-Packard increased its research spending from 8.7 percent of sales revenues in 1980 to 10.5 percent of sales in 1983. GCA Corporation increased its R&D expenditures as a percentage of sales from 8.6 percent in 1981 to a projected 15 percent in 1984. The Foxboro Company showed a similar increase from slightly more than 6 percent in 1981 to 8.6 percent in 1983. IBM stated in its submission to this Subcommittee that the R&D credit was a significant factor in its decision to sharply increase R&D spending to the point where in 1982, 1983, and likely 1984, R&D spending grew more rapidly than revenue -- with a three-year compound growth rate for IBM R&D spending of more than double the rate for the previous five years.

This pattern of increased R&D spending by companies -- both in absolute terms and as a percentage of sales revenues -- is perhaps the best evidence upon which to judge the

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29/ See Letter from John T. Hickey, Executive Vice President and Chief Financial Officer, Motorola, Inc. to William A. Kirk, Jr., September 12, 1984; Letter from John A. Young, President and Chief Executive Officer, Hewlett-Packard Company, to Chairman Charles B. Rangel, September 14, 1984; Letter from Charles A. McKay, Executive Vice President, The Foxboro Company, to Chairman Charles B. Rangel, August 21, 1984; Letter from Richard A. Bissell, Manager of Taxes, GCA Corporation, to Chairman Charles B. Rangel, September 17, 1984; Letter from John G. Boyd, International Business Machines, to Chief Counsel John J. Salmon, September 17, 1984.

effectiveness of the credit. For most high technology companies, the corporate budgeting process is of such a scale that it is difficult to identify specific projects that may have been undertaken or aided by the R&D credit. For example, as John A. Young, President and Chief Executive Officer of Hewlett-Packard noted in his submission to the Subcommittee, his company undertakes research by means both of a central laboratory and the activities of the company's forty U.S. divisions, each of which undertakes R&D on an annual scale that often exceeds $20 million. Research budgets are established for Hewlett-Packard as a whole and within each division. Therefore, while Mr. Young states that the R&D credit was a significant factor in determining these budgets over the past three years, Hewlett-Packard's decentralized approach to research makes it difficult to determine precisely which specific product or experimental activity was undertaken directly as the result of the credit. 30/ Similarly, on an industry-wide basis, it is abundantly clear that the funds allocated to corporate research have grown significantly during the period since the enactment of the R&D credit.

30/ In addition, individual companies are understandably reluctant to discuss the credit's effect in terms of ongoing or recently-completed R&D projects for fear of jeopardizing the proprietary aspects of these projects.

These electronics industry data show a consistent pattern of rates of increase in investments in R&D beyond that which could previously be expected or predicted. While it cannot be conclusively proved that the R&D credit caused these R&D spending increases, these results are exactly what one would expect from an effective incentive.

Eisner Analysis of Aggregate Data

In his testimony before the Subcommittee Professor Robert Eisner stated [31] that he attempted to determine whether the R&D tax credit had any significant impact in encouraging corporate R&D spending by comparing rates of growth in R&D spending for firms which could use their entire credit to offset current tax liability, firms whose tax liability was positive but less than the amount of credit, and firms which lacked tax liability entirely. Eisner's argument is that if the R&D credit were a true stimulus to R&D spending, then firms that could apply the full credit amount to offset current tax liability should increase their spending more than firms which could not use some portion or all of their credit. From his analysis Eisner concludes that the credit did not significantly affect R&D spending levels.

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[31] *See* Eisner, *supra*, at 11-13.

However, since Eisner's data applied only to 1981 and 1982, his analysis is, by his own admission, very preliminary. Moreover, for 1982 his statistical comparison of R&D growth by companies eligible and ineligible for the credit does show that R&D spending of companies eligible for the credit grew at a significantly higher rate. Other possible explanations for this difference were not tested or even suggested.

More fundamentally, Eisner's analysis assumes that the credit provides substantially less of an incentive for all taxpayers with insufficient tax liability than for other taxpayers. This assumption is wrong in many, and perhaps most, cases. For example, the Treasury data that Eisner used fail to indicate whether the firms unable to use their R&D credits in the current year could carry back their credits under the statutory provisions permitting a three-year carryback (followed by a fifteen-year carryforward). Since the recession temporarily reduced many taxpayers' taxable income, it is quite likely that many firms could carry back and utilize most or all of their credits in profitable years -- giving rise to an immediate tax refund, which has essentially the same positive financial impact as a credit usable against current tax liability. In addition, some other companies which were required to carry the credit forward still would likely see the credit as a significant incentive if they believed that they would have the tax liabilities to offset against the credit in the near future once the recession ended. As GCA Corporation noted in a submission to the Subcommittee: "The R&D tax credit has provided our company with funds to expand research and development during slow economic times. The high technology industry was particularly hard hit by the recession in 1982, but GCA Corporation was able to press on with activities to develop new products, significant product enhancements and new features, with the knowledge that the benefit of R&D credits earned in 1981, 1982 and 1983 would be fully realized in 1984." 32/

Finally, Eisner's analysis assumes that those taxpayers whose credit exceeded their current tax liability were able to foresee that fact at the point at which their R&D expenditures were planned. In essence, he assumed that taxpayers could predict, at the time they established their R&D budgets (e.g., a year or more in advance of actual expenditures), that the amount of their credit would exceed their current tax liabilities. For all but a handful of companies (most of which probably had declining R&D in any case), this assumption is likely to be incorrect.

For all these reasons, it is difficult to view Eisner's analysis of aggregate data as providing any basis for

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32/ Letter from Richard A. Bissell, Manager of Taxes, GCA Corporation, to Chairman Charles B. Rangel, September 17, 1984.

the conclusion that the credit is not encouraging expanded industrial R&D efforts.

Company Surveys of R&D Spending and the Tax Credit

To date at least three surveys of corporations and the R&D credit have been initiated. Two of these surveys, undertaken by Professor Edwin Mansfield of Pennsylvania 33/ and by the General Accounting Office, 34/ were discussed extensively at the Subcommittee hearings. 35/ These surveys attempt to assess the extent to which the R&D credit has been perceived as a factor in determining increases in R&D expenditures.

Mansfield's study, based upon a survey of companies during 1981 through 1983, suggests a relatively small corporate response to the R&D credit in some industries, but a significant response in others (*e.g.*, instruments). However,

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33/ Mansfield, "Public Policy Toward Industrial Innovation," *supra*.

34/ Statement of Johnny C. Finch, Senior Associate Director, General Government Division United States General Accounting Office, before the Subcommittee on Oversight, Committee on Ways and Means, House of Representatives, on the Use and Effectiveness of the Research and Experimentation Tax Credit, August 2, 1984.

35/ The third survey, undertaken by Bain & Co., for the American Electronics Association indicated that the credit may have led AEA member companies to increase their R&D investments by as much as 9 percent in 1983.

his study fails to indicate in any detail which companies were surveyed. His data on dollar increases in R&D spending for the computer and electrical and electronics industries are inconsistent with actual industry numbers. Thus, it appears likely that his survey missed some major R&D-intensive companies.

The General Accounting Office survey leads to a quite different conclusion. GAO found that of the 86 companies in its sample which had claimed the credit, 56 companies were encouraged by the credit to initiate new research projects, intensify the level of their ongoing research efforts, or both. These 56 companies spent 95 percent of the R&D expenditures of all 86 companies in the sample. 36/

In analyzing these surveys it should be kept in mind that any such surveys have significant limitations as fact-finding tools. First, surveys must ask for subjective responses of corporate personnel. These responses may be influenced by extraneous considerations. For example, the strong desire for strict corporate secrecy about R&D plans and specific projects affects the responses of many corporate

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36/ *See* GAO testimony at page 17. This result is consistent with the theory that small businesses (*i.e.*, the thirty companies surveyed incurring only 5 percent of total research) are generally slower to change their behavior based on tax incentives.

officials. In addition, some corporate officials are known to believe it reflects adversely on their business judgment to admit that short-run considerations such as tax savings significantly affect important business decisions. Other officials, of course, might target their responses to further perceived political goals.

Second, it is crucial to any accurate survey determination of a tax incentive's effectiveness that the survey be answered by a corporate official who actually knows the specific facts of how R&D budget decisions were made. As Allen Krowe of IBM testified 37/ before the Subcommittee, most mid- and lower-level corporate officials (including senior R&D officials) are likely not to be in a position to know sufficient facts with respect to their companies' decisionmaking processes to be certain of the extent to which various factors influenced both overall and specific investment decisions.

Finally, surveys have inherent limitations as empirical tools because of the way in which any incentive, like the R&D tax credit, is taken into account in corporate decisionmaking. Corporate witnesses at the Subcommittee

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37/ Written Statement of Allen J. Krowe, Senior Vice President for Finance and Planning, IBM Corporation, before the Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives, August 3, 1984, at 12-13.

hearing were virtually unanimous in stating that their companies did in fact take the credit into account in R&D budget decisions. 38/ The corporate responses to the series of questions asked by Chairman Rangel after the hearing also indicate the credit was a factor in decisions to increase corporate R&D spending. But for any company the credit, like any tax incentive, inevitably is only one of a series of factors that influence R&D spending decisions. 39/ It is thus generally difficult -- especially after the fact -- for any corporate official to state that the credit caused any specific dollar increase in R&D or that any specific R&D project would have been scrapped without the credit.

Thus, while companies can and consistently do state (as in the GAO study and direct Subcommittee testimony) that the credit did lead to R&D increases, they are not likely to be able to quantify in any more than a general sense the total impact of the credit in specific dollar amounts overall or on

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38/ See, e.g., Statements of Young (CBEMA), Hickey (SIA), Krowe (IBM), Saloom (American Electronics Association), Taylor (Scientific Apparatus Makers Association), and Ross (AT&T - Bell Laboratories).

39/ Other important factors include the availability of investment funds, the capital needs of a company for plant, equipment and other expenditures, the availability of R&D manpower and materials in the proper locations, and the underlying presence of scientific discoveries on which product-directed R&D can be based.

specific projects. For these reasons, even though the credit in fact influences corporate decisionmaking in a substantial and positive direction, it should not be surprising that surveys of company officials do not elicit sufficient information to document the precise magnitude of the credit's impact.

How the Tax Credit Increases R&D Spending

Actual Company Experience

The aggregate and industry level R&D data discussed above demonstrate that R&D budgets fared well when compared with the budgets of most other corporate departments during the tight financial squeeze brought about by the severe recession in 1981-83. An important reason for the continued strength in R&D spending during this period, according to a National Science Foundation survey and the experience of AEA, CBEMA, SAMA and SIA members, is that despite the high degree of economic uncertainty, lower profit levels, and higher interest rates, corporate R&D personnel were able to argue persuasively for the expansion of R&D activities because of the more favorable tax treatment such activities receive under the credit. 40/ As a Foxboro Company Vice President observed in a

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40/ See National Science Foundation, "Science Resources Highlights," September 9, 1982, NSF 82-324.

submission to the subcommittee:

> In these difficult economic times, with incoming order rates down, shipments down, and profits down, there is very strong pressure to cut costs of all types, including R&D expenditures. The R&D tax credit has proved to be an effective tool which I have used successfully in my efforts to increase our research and development activities.
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> During the last three years, Foxboro's R&D expenditures have steadily increased despite a corresponding decline in sales over the same period. The R&D tax credit has played a significant role in our company's ability to increase levels of R&D spending in the face of declining profits. In fact, our R&D expenditures were about 15% more in both 1982 and 1983 than they would have been without the credit. 41/

During the present period of strong economic growth, the R&D credit continues to provide significant leverage to R&D departments in corporate budget decisionmaking.

The R&D credit provides such leverage because it has a direct impact on the financial costs of R&D budget decisions. While R&D expenses, unlike investments in plant and equipment, directly reduce corporate pre-tax earnings in the year in which they are incurred, the R&D tax credit provides a corresponding direct benefit to the company's earnings in the year of the increased R&D expenditure. Because of this direct benefit, a

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41/ Letter from Charles A. McKay, Executive Vice President, The Foxboro Company, to Chairman Charles B. Rangel, August 21, 1984.

company can spend substantially more on R&D with a smaller financial statement impact than otherwise would be possible. For example, if prior to the enactment of the credit a company with tax liabilities spent an additional $10 million on R&D projects, the increased expenditure would decrease after-tax earnings by $5.4 million. 42/ By contrast, taking into account the R&D credit (assuming that the additional R&D expenditures are qualified and incremental), the after-tax financial statement impact of the increase $10 million in R&D is reduced to approximately $2.9 million. 43/ The credit thus makes a major difference in the fundamental calculations of corporate officials who are responsible for maintaining corporate earnings levels. It does exactly what any proper governmental incentive for R&D is supposed to do: it reduces the private investor costs of R&D to bring that cost more in line with the level of private benefits which the investor will be able to capture if the project is successful.

42/ This amount is calculated by assuming the $10 million expenditure, all of which is deductible, reduces corporate tax payments by $4.6 million, thereby costing the company $5.4 million on an after-tax basis.

43/ If all $10 million is qualified and incremental, the credit attributable to the $10 million expenditure is $2.5 million, which reduces the after-tax cost of the expenditure from $5.4 million to $2.9 million.

As a Foxboro Company Vice President stated in its submission to this Subcommittee: "[T]wo projects which I feel were approved due to the existence of the R&D tax credit. These projects are 1) a $4 million Micro-Technology Center; and, 2) a custom LSI Design Project. These projects represent ventures into brand name technologies and were in serious jeopardy due to budget constraints. Approval of these projects was in large part due to benefits which would be gained from the R&D credit which had a favorable impact on our return to investment computations." 44/

Eisner Benefit Theory

Professor Eisner and others in the academic community have criticized the current structure of the R&D credit on the ground that, under a time value of money analysis, the effective rate of the credit is much lower than the 25 percent statutory rate for those taxpayers whose R&D expenditures are growing on a regular basis. 45/ Since the R&D credit is calculated as 25 percent of the excess of qualified research expenses in the current year over the annual average of

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44/ Letter from McKay, Foxboro, to Chairman Rangel, supra.

45/ This theory under a time value of money analysis is, of course, nothing new. It was known at the time the credit was enacted and was described in detail in tax literature in late 1981. See, e.g., Sunley, "The New 25% R&D Credit -- What Is It Worth," Tax Advisor, December, 1981, 735-737.

qualified research expenses for the immediately preceding three-year period, any increases in company R&D expenditures in the current taxable year are included in the company's base period against which incremental R&D spending is measured for each of the next three years. Thus, each additional dollar of credit in the current year reduces the available credit in each of the next three years by 33 cents. For example, $12 of increased R&D spending in the current year would provide a $3 credit in such year, but would reduce the otherwise available credit by $1 in each of the succeeding three years. Under the time value of money analysis, the net tax benefit to the company from the credit is calculated to be the difference between $3 and the sum of the present values of one dollar in each of the next three years.

Based on this analysis, Eisner views the credit's incentive value as the value of the acceleration in the receipt of the credit's tax benefit as described above. At discount rates of between 10 and 15 percent, the value of this acceleration of tax benefit is the equivalent of a 4 to 6 percent credit, rather than a 25 percent credit.

The principal problem with this analysis is not that it is theoretically incorrect but that it is simply irrelevant -- it does not reflect the manner in which real world corporate decisionmaking actually occurs. The analysis can lead to the conclusion that the incentive value of the credit is 4 to 6 percent and not 25 percent only if the analysis is in fact applied by companies in making corporate R&D budget decisions. But corporate budget decisions are based on calculations of costs and income as determined for financial reporting purposes. Companies taking the R&D tax credit into account in budget decisionmaking do not treat the credit as a reduction in current taxes with an offsetting increase in future taxes, as would be proper under the time value of money analysis. Generally accepted accounting principles do not permit such deferred tax treatment for the credit. 46/ Instead, the R&D credit is properly accounted for as a reduction in full in income taxes in the period in which the tax credit is received. On that same basis, corporations properly treat the full benefit of the credit as attributable to that same period for internal budgeting and management purposes. The fact that this accounting treatment, and not the treatment Eisner assumes, is in fact followed in corporate decisionmaking was indicated by several witnesses before the Subcommittee. 47/

Any analysis of the effectiveness of the R&D credit as an incentive must be predicated upon a correct understanding

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46/ See, e.g., Accounting Principles Board Opinion Nos. 9 and 11; American Institute of Certified Public Accountants Accounting Interpretations of APB Opinion No. 11.

47/ See, e.g., Statements of Young (CBEMA), supra, at 12-13; Krowe (IBM), at 12-14, supra.

manner in which the incentive actually is incorporated into corporate decisionmaking. To judge the effectiveness of the credit as an incentive based on theories which are not in fact relevant to corporate decisionmaking is merely an academic diversion, but one which can lead to irrelevant concerns and distorted conclusions.

TAX CREDIT FOR CORPORATE SUPPORT OF UNIVERSITY BASIC RESEARCH

The high technology industries recently have experienced tremendous and rapid growth in product innovation and market development. Future growth in high technology will be able to continue only if corresponding advances are made in the foundations of knowledge in the fields of engineering and physical science which underlie such technology. However, very little incentive exists today for a particular company to undertake basic research projects. Such research by definition has no immediate commercial application and its benefits in the form of advancement in the state of knowledge generally are broadly dispersed across industry and academia.

The current R&D tax credit applies to corporate funding of university basic research in essentially the same manner as to any other corporate contract research. Prior to the enactment of the credit, basic research in this Nation had been suffering from a long decline. Industry spending on basic research was down from 7.6 percent of every research dollar in 1960 to 4.4 percent in the late 1970's, and industry support of university R&D had decreased by over 30 percent since 1960 to a scant 4.1 percent of R&D dollars brought to universities. 48/

Also as the result of the dramatic surge in technological progress in the last 20 years, the costs to our universities of educating future scientists and engineers and of performing the basic research necessary to continuing technological progress have increased rapidly. Both the increasing complexity of the technology and the need for sophisticated capital equipment which is subject to early obsolescence have increased costs substantially.

Both industry and universities benefit from the expansion of knowledge which can be achieved through expanded university basic research efforts. Just as importantly, through expanded research our universities receive substantial resources to improve their scientific education and training programs. At our colleges and universities, education in mathematics, engineering, and the physical, biological, and computer sciences has suffered from a chronic shortage of faculty and a lack of up-to-date scientific facilities and equipment upon which the students and faculty can learn and perform research. Universities not only face great difficulty

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48/ Written Statement of Larry A. Sumney, Executive Director, Semiconductor Research Corporation, Before the Subcommittee on Oversight of the House Committee on Ways and Means, August 3, 1984, 4.

in stretching tight budgets to compete with private industry for faculty, but they also face difficulty in attracting high caliber faculty because of teaching overload generated by faculty vacancies and the antiquated laboratory facilities available for teaching and research. The result of these chronic shortages of university science faculties and antiquated laboratory facilities is an inadequate supply of scientifically-skilled labor, especially in critical areas such as computer science, electrical engineering, and mechanical engineering.

Increased corporate funding of university basic research must be a major factor in any effort to provide universities with the financial resources to attract scientific faculty and to modernize laboratory facilities. These modernized facilities, in turn, will help attract high caliber faculty by providing more up-to-date laboratories within which the faculty member can perform his or her research. In addition, the university basic research projects conducted in cooperation with industry will constitute a significant attraction to new faculty by providing the opportunity to work on a well-funded project examining research problems and issues that are on the frontier of the scientific fields underlying industrial technology. To the extent that through these efforts faculty shortages are remedied and the scientific facilities are modernized, the supply of scientists, engineers, and scientifically-trained manpower will be expanded, and a pool of highly-trained talent will be available not only to the high technology industries but to a broad range of industries across this Nation as well. 49/

The early experience with the university basic research provisions in the current R&D credit has demonstrated that industry will respond to a tax incentive for funding university basic research. Larry Sumney, Executive Director of the Semiconductor Research Corporation, a non-profit organization formed by companies in the semiconductor industry to promote basic research by pooling company membership fees and contracting with universities throughout the country for the creation of major research centers and specific research projects, testified before this Subcommittee that:

> SRC's experience, we believe, helps demonstrate that industry has responded to the incentives contained in the present R&D tax credit for corporate support of university basic research. In the two years since SRC was formed, its membership has grown from ten to twenty-six companies, and its budget for its activities has increased from approximately $6 million in 1982 to over $15 million for 1984.
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> . . . [I]n SRC's first full year of operation in 1982, it received over 150 proposals from 52 universities from around the nation in response to its initial request for university basic research

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49/ Written Statement of Sumney (Semiconductor Research Corporation), supra, at 5-7.

> proposals. SRC has awarded 50 contracts for major research "centers-of-excellence", major research programs, and individual university research projects. 50/

Mr. Sumney testified that the R&D credit has been an important factor in the creation and subsequent growth of SRC's collaborative funding of university basic research, both because of the positive environment for R&D and university basic research which existed with the enactment of the credit and because of SRC's ability to use the tax credit as a positive sales tool to attract corporate members willing to fund university basic research activities. 51/

SRC's experience with the university basic research credit has been confirmed by individual company experience. As Digital Equipment Corporation noted in a submission to this Subcommittee: 52/ "The R&D tax credit's greatest impact at Digital has been in the area of research grants to and contract research with universities. Prior to the credit, Digital made occasional research arrangements with universities. In fiscal 1984, Digital will show a charitable deduction of $17 million

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50/ Written Statement of Sumney (Semiconductor Research Corporation), supra, at 8.

51/ Id.

52/ Letter from Albert E. Mullin, Jr., Vice President, Corporate Relations, Digital Equipment Corporation to Chairman Charles B. Rangel, October 3, 1984.

for equipment given to universities under section 170(e)(4) of the Internal Revenue Code. Digital also will spend in excess of $30 million for contract research with universities. Fiscal 1985 spending for contract research with universities may exceed $65 million." Similarly, GCA Corporation noted: "In addition, the R&D credit was a major catalyst to the execution of research agreements with nine major educational institutions for basic robotics research." 53/ IBM, in describing the effect of the credit on its research activities, observed: "IBM's cooperative research with U.S. universities has grown rapidly in recent years, to the point that more than 910 projects have been initiated -- over 460 of which are now active with 135 different institutions, representing a current multi-year IBM commitment of over $90 million." 54/ This pattern of growth in corporate support of university basic research in the period since the enactment of the R&D credit

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53/ Letter from Richard A. Bissell, Manager of Taxes, GCA Corporation, to Chairman Charles B. Rangel, September 17, 1984.

54/ Letter from John G. Boyd, International Business Machines Corporation, to Chief Counsel John J. Salmon, September 17, 1984.

also is confirmed by the testimony before this Subcommittee of the various representatives of the academic community. 55/

While the response of industry to the existing university basic research credit incentive has been substantial, great potential exists for an even broader expansion of such funding if the present tax incentive were enhanced. The present R&D credit treats corporate payments to universities for basic research in the same manner as a contract payment to any research company or organization for product development. Thus, the credit provides no incentive for a company to shift its funding from corporate internal (or contract) R&D to university basic research. Such a shift can only be encouraged by establishing a differentially large tax credit incentive for university basic research. This differentially larger incentive could take the form of a flat rate university basic research credit, as originally approved by the full Ways and Means Committee in 1981, or a non-incremental credit for corporate basic research payments to universities which are in excess of a fixed "maintenance-of-effort" level, as included in the Senate-passed R&D legislation in 1984. AEA, CBEMA, SAMA and SIA strongly recommend that legislation extending the R&D credit beyond 1985 include such a provision to expand corporate funded university basic research.

55/ See Written Statements of Stephen Kahne, Dean of Engineering, Polytechnic Institute of New York, on behalf of the American Society for Engineering Education and Steven C. Beering, M.D., President of Purdue University on behalf of the Association of American Universities and the National Association of State Universities and Land-Grant Colleges, before the Subcommittee on Oversight, House Committee on Ways and Means, August 3, 1984.

STRUCTURAL CRITICISMS OF THE R&D CREDIT AND PROPSOALS FOR CHANGE

Base Period Determinations

Effect on companies with declining R&D

One criticism of the current structure of the R&D credit has been that its incremental feature eliminates any benefit to companies with declining R&D. Professor Eisner estimates that 6.1 percent of all R&D in 1981 and 15 percent of all R&D in 1982 was performed by taxpayers whose current R&D spending was below their base period levels.

The Business Week R&D survey for 1983 suggests that even fewer firms were in the "below base" category. The survey shows that 103 out of 800 firms (12.9 percent) decreased their 1983 R&D spending from estimated base period levels (assuming that a 12 percent decline in 1983 would, on average, be the cutoff point for being below base). Most of these firms either were small in overall size or had relatively small R&D budgets. No more than 5 percent of the total R&D by firms in the survey was conducted by firms that were below this estimated base. Thus, relatively few taxpayers are not eligible for the credit with respect to decisions to increase R&D spending.

Obviously, the fact that some companies are not eligible for the credit makes this aspect of its present structure less than fully desirable. Yet, eliminating the incremental feature of the credit inevitably produces other and perhaps more serious difficulties. The R&D credit can be an effective incentive only if it: (1) provides a substantial level of benefit through a relatively high credit rate and (2) applies to marginal decisions to undertake R&D projects which in the absence of the credit might not be undertaken. The present incremental structure of the credit fulfills these requirements for most taxpayers. Of the alternatives to this structure, a low rate, nonincremental credit would address the problem of taxpayers with declining R&D, but would badly dilute the incentive for the bulk of taxpayers. On the other hand, a high rate, nonincremental credit would address the problem without diluting the incentive, but would have a high revenue cost both in absolute terms and in comparison to the overall incentive effect of the credit.

Given budgetary constraints, the serious policy question is what compromises must be made in the structure of the base period in order to moderate the revenue loss from the credit while preserving the credit as an effective incentive for most if not all taxpayers. The incremental feature of the credit was in 1981 perceived to be the best compromise to balance these policy goals. While the impact of this decision is to eliminate the incentive effect of the credit for those relatively few taxpayers whose R&D spending is declining, the full incentive is provided for the many taxpayers who are seeking to increase their R&D over prior periods. AEA, CBEMA, SAMA, and SIA supported the congressional decision to employ the incremental feature when the credit originally was enacted and continue to support that decision today.

Alternative bases for incremental credit

At the Subcommittee hearing a few witnesses suggested changing the base period from a taxpayer's level of R&D spending over the most recent past three years to other types of bases, such as historical company R&D levels increased by current rates of inflation or by economy-wide average R&D increases. The intended improvement from these suggested changes is elimination of the time value of money effect of the credit which, as was discussed above, 56/ some believe dilutes its incentive impact. However, if it is concluded that the time value of money effect of the credit does not in fact dilute its incentive significantly because of the manner in which the credit actually is taken into account by companies, the need to consider these changes in the base period is unclear.

Because of academic interest in various base period changes, a number of alternatives were studied in some detail

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56/ See pages 49-52 above.

by a group of twenty electronics companies in 1983. 57/ The conclusion of that group, which AEA, CBEMA, SAMA and SIA support, is that while these alternatives should be considered, each appears to have sufficient disadvantages or technical complexities as to likely make them less desirable than present law. Nonetheless the associations would be glad to explore any of these alternatives with the Subcommittee and its staff in more detail.

Fifty percent minimum base period

An additional criticism of the credit's structure that has been raised is that companies with very rapid growth in R&D spending fail to receive the full benefit of the R&D credit because of the so-called "50 percent limitation" of section 44F(c)(3). That limitation provides that the base period for any year cannot be less than 50 percent of current year R&D expenses.

The associations joining in this paper would support a recommendation of the Subcommittee to remove this limitation on the credit. However, in considering any such recommendation several factors should be kept in mind.

57/ See High Technology Tax Policies for the 1980's, A Report of the Ad Hoc Electronics Tax Group, January 1984, at 43-45.

First, existing data indicate that a relatively small number of taxpayers are subject to the 50 percent limitation. The limitation applies only to companies whose R&D is growing so rapidly that current year spending exceeds 100 percent of base period average spending. In Business Week's 1983 R&D survey, 30 of the 800 firms (less than 4 percent) surveyed had 1983 R&D levels which were estimated to exceed 100 percent of base period levels. Second, the firms likely to be subject to the limitation are relatively small. Third, the limitation does not affect all of the R&D increase of any company but only the portion that actually is above the 100 percent-of-base period expenditures. 58/ Given this fact and the small number and size of affected companies the total amount of R&D affected by the 50 percent limitation is likely to be very small. The 30 companies in the Business Week survey estimated to be subject to the limitation spent only $70.2 million on R&D in

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58/ For example, assume that a company has a base amount of 50 and a current year amount of 100, for a creditable amount of 50 and a total credit of 12.5. If the company decides to spend an additional 10 in the current year for a total of 110, upon application of the § 44F(c)(3) limitation (under which the base amount cannot be less than 50 percent of the current year amount) the base would slide up to 55, for a total creditable amount of 55 and a total credit of 13.75. Thus, the additional 10 of R&D spending increases the total credit by 1.25, with an effective credit rate of 12.5 percent. In essence, the amount spent up to the limitation receives the full 25 percent credit rate, while the amount in excess of the limitation receives a reduced credit rate of 12.5 percent.

excess of 100 percent of their base. This amount is less than 0.2 percent of R&D expenditures for the entire sample.

Eisner states that 9.2 percent of the qualified research in 1981 was conducted by firms whose R&D exceeded 100 percent of the base amount. However, since only the R&D above the 100 percent limitation was subject to the lower 12.5 percent credit, a much lower percentage of R&D expenditures was affected by the limitation. Conceivably, even under his analysis less than 1 percent of all R&D spending in 1981 was subject to the 100 percent limitation.

Finally, it should be noted that the 100 percent limitation on the incremental credit was adopted to permit the credit to provide a substantial incentive for R&D while, at the same time, remaining within acceptable revenue levels. Indeed, in 1981 the limitation was first included by the Ways and Means Committee in its reported R&D credit provisions primarily to reduce the revenue impact of the credit and secondarily to limit the extent of the tax benefit given to very fast growing companies.

Tax Liability Limitation

Professor Eisner and others have said that the R&D credit is a questionable incentive because of its limited utility to companies with no tax liability. 59/ Professor Eisner's estimate is that in 1982 at least 32 percent of the potential credit could not be used because the taxpayers had no tax liability against which to offset the credit. Of course, the relatively large number of corporate taxpayers with no tax liability in 1982 resulted from the severe economic recession experienced in late 1981 and 1982. Now that the recession has ended and has been succeeded by a period of exceptionally robust growth, the number of corporate taxpayers without tax liability should diminish substantially.

Moreover, this concern about the limited utility of the R&D credit to taxpayers without tax liability is equally applicable to all business tax deductions and credits, none of which can be used if the taxpayer lacks liability. The R&D credit provisions do permit a generous carryback of unused R&D credits to the preceding three taxable years followed by a carryforward to the succeeding fifteen years.

Some companies have no tax liability because they have benefited from other favorable provisions of the tax code. Whether these companies should receive current year benefits from the R&D credit is at best unclear. For other companies, such as start-up companies and those with operating losses from

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59/ See Eisner, *supra*, at 4; Mansfield, *supra*, at 12-14 declining markets or foreign competition, the question is more difficult. But the fact that these companies must carry over their R&D credits does not mean that the R&D credit is an inconsequential incentive for them. Indeed, some of these companies, such as machine tool builders, have been among the strongest supporters of the R&D credit, viewing the credit as a future incentive for their modernization efforts. 60/

In any case, the only solution to the problem of limited tax liability is to make the R&D credit refundable. That solution would involve a significant additional revenue cost and would breach well-established U.S. tax policy principles. It is not supported by AEA, CBEMA, SAMA, and SIA. Instead, these organizations support the provisions in the Senate-passed R&D legislation that make the credit available to start-up corporations -- which by definition have no tax liability -- thereby encouraging budding research efforts at the small business level.

Availability of a Tax Credit and a Deduction for the Same R&D Expenditure

At the Subcommittee hearing the question was raised as to whether a tax credit and a deduction should be available for

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60/ *See* Written Statement of W. Paul Cooper, Chairman, Executive Committee, ACME-Cleveland Corp., on behalf of the National Machine Tool Builders' Association.

the same research expenditure. In this regard, some have suggested the possibility of a so-called "basis adjustment" -- really a deduction disallowance -- under which the deduction for R&D expenses for a particular taxable year would be reduced by part or all of R&D credit claimed in that year. It should be noted that of all of the foreign country competitors that provide an R&D credit, only one, Canada, reduces current R&D deductions where the R&D credit is claimed, and Canada offers a generous system of special R&D allowances, in addition to the current deduction and tax credit, that are unavailable under the U.S. tax system.

Moreover, in substance the issue here should not be whether or not some "double benefit" exists by allowing both a deduction and a credit for R&D spending. The whole basis for establishing an R&D credit is to provide an incentive -- i.e., some tax benefit beyond the mere deduction of R&D costs -- for the variety of reasons discussed earlier in this paper, including compensation of R&D investors for incurring costs which will yield public returns far in excess of the private returns to the investor. Thus, the proper issue with respect to any basis adjustment or deduction disallowance is the appropriate level of incentive for R&D activities.

For corporations, a deduction disallowance to the extent of the credit has the same impact as a reduction in the R&D credit rate by 46 percent. If deductions in an amount equal to the credit are lost, tax liabilities are increased by 46 percent of the amount disallowed (i.e., the amount of the credit). Therefore, a full deduction disallowance to the extent of the credit is the mathematical and economic equivalent of reducing the credit rate from 25 percent to 13.5 percent with respect to most corporations. Such a rate reduction would substantially undercut the incentive effect of the credit. It would be strongly opposed by AEA, CBEMA, SAMA and SIA.

Concerns Over Possible "Creative Accounting"

Professor Eisner 61/ asserts that at least in 1981 firms that claimed the R&D credit may have exaggerated their R&D spending levels for tax purposes by stretching the definition of qualified research to embrace activities that were not truly R&D. Eisner deduces this conclusion from the fact that firms in the Treasury Office of Tax Analysis (OTA) sample claimed an increase in R&D in 1981 over 1980 that substantially exceeded the increases noted in the Business Week National Science Foundation (NSF) and Compustat surveys. However, the OTA sample included only those firms that claimed the credit, as compared with the surveys which were based on financial reporting numbers and likely included firms that did

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61/ See Eisner, *supra*, at 3.

not claim the credit. It is not unreasonable that those companies claiming the credit would experience more rapidly-growing R&D spending than firms which did not claim the credit.

In addition, prior to 1981 most companies had no strong reason to keep a detailed and precise record of the various types of all R&D costs. In its written testimony before this Subcommittee, The General Accounting Office noted the difficulty faced by firms in reconstructing prior year accounting records for base year purposes after the credit was enacted. 62/ Thus, much of this so-called "creative accounting" may simply have been a phenomenon arising for legitimate reasons relating to the problems of retroactive accounting for 1980.

Perhaps more importantly over the long run, the incremental feature of the credit provides a "self-policing" mechanism which makes any discrepancy of qualified R&D activities likely to be a transitory initial phenomenon. All years after 1980 are credit earning years before they are base period years. Thus, companies would not likely understate their current year credit in order to reduce their future year base period. Moreover, any companies overstating their

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62/ See GAO Written Statement, supra, at 16.

qualified R&D in the current year would face a higher base period amount and a correspondingly diminished credit in subsequent years. Therefore, "creative accounting" should not be a substantial concern for years after 1981.

Nonetheless, to further reduce any remaining concerns over "creative accounting" in the future, AEA, CBEMA, SAMA, and SIA support the tightened, more precise definition of qualified research for credit purposes that was included in the Senate-passed R&D legislation. The changes included in that definition are described in more detail below. In its testimony before the Subcommittee, Treasury strongly endorsed the revised Senate definition as satisfactorily addressing its concerns as to "creative accounting" as well as its other concerns with respect to the current law definition.

Definitional Difficulties under Present Law

Apart from any so-called creative accounting issues, serious difficulties have arisen in defining those activities which constitute qualified research under the present structure of the credit. These difficulties stem in large part from the 1981 decision of the Administration (supported by the Senate) that the definition of R&D activities under Code Section 174 should be applied for credit purposes. In its version of the 1981 Act, the Ways and Means Committee disagreed with the Senate view and adopted a new, more specific definition as an alternative. The four associations participating in this paper supported the Ways and Means alternative. That provision, unfortunately, was not enacted, and under the present credit Section 174 provides the basic authority for determinations of qualified research.

Section 174 is a relatively brief statutory provision which has received little interpretive guidance from the IRS and the courts. It permits taxpayers to reasonably claim the credit with respect to a broad range of activities. The Internal Revenue Service has attempted to limit somewhat the scope of Section 174 in certain instances by issuing restrictive proposed regulations. But these regulations are technically imprecise, and in many respects the regulations (particularly as they relate to software) would be subject to serious legal challenge if they were finalized. Thus, continued use of the present Section 174 definition for credit purposes is now seen as undesirable by the Treasury Department. 63/

While definitional difficulties have arisen under the credit's present structure, Treasury believes that the definition proposed in the Senate-passed R&D legislation

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63/ See Statement of Ronald A. Pearlman, Acting Assistant Secretary (Tax Policy), Department of the Treasury before the Subcommittee on Oversight of the Committee on Ways and Means, August 2, 1984.

properly resolves most difficulties arising under present law. AEA, CBEMA, SAMA, and SIA share Treasury's view. That definition is a Congressional staff compromise between the revised definition originally proposed by private sector representatives and the revised definition outlined by Treasury in earlier Senate testimony. 64/ As finally agreed upon, the compromise definition narrows the category of eligible activities for credit purposes in several important ways.

Functional Not Stylistic Products And Improvements.

Under the proposed compromise definition eligible R&D activities for credit purposes are limited to those activities directed toward functional improvements (e.g., function, performance, reliability), thereby eliminating the entire category of style, taste, cosmetic, and seasonal design improvements often undertaken purely or predominantly for marketing purposes. The requirement that "substantially all" of the R&D activities constitute experimentation directed toward functional changes sets a high standard which companies must meet before their development activity will be held to be "qualified research."

64/ See Statement of John E. Chapoton, Assistant Secretary (Tax Policy), Department of the Treasury before the Subcommittee on Taxation and Debt Management of the Senate Finance Committee, February 24, 1984.

The present law definition of qualified R&D for credit purposes in section 174, by contrast, can be interpreted to apply to the development of virtually all new or improved products, including products that are developed solely on the basis of their appeal to consumer tastes and style and other marketing aspects. Under this broad present law definition, a taxpayer would have a strong basis upon which to argue that a food or beverage product or apparel or textile product qualified in the same manner as any other new or improved product, even though the R&D related to the taste elements of the food product or to the seasonal design and style elements of the apparel item.

The compromise definition eliminates these activities from the credit. As Table 3 indicates, this change would substantially curtail if not eliminate the amount of R&D credit claimed with respect to activities undertaken in the following industries.

Table 3

Compromise Definition: Impact of Style and Taste Limitations

Industry Code	Industry	1981 Credits Claimed (Thousands of $)
2010	Meat Products	477
2020	Dairy Products	928
2030	Preserved Fruits & Veg	1,435
2040	Grain Mill Products	1,614
2050	Bakery Products	862
2060	Sugar & Confectionery	381
2081	Malt Liquors & Malt	346
2088	Alcohol Bev, Ex Malt	451
2089	Bottled Soft Drinks	571
2096	Other Food & Kindred	2,777
2100	Tobacco Manufacturer	3,470
2228	Weaving Mills & Textiles	967
2250	Knitting Mills	369
2298	Other Textile Mills	1,170
2315	Mens and Boys clothing	657
2345	Womens and Childrens Clothing	330
2388	Other Apparel & Accessories	91
2390	Misc. Fabricated Textiles	398
Total		17,294

SOURCE: U.S. TREASURY DEPARTMENT

Financial and Management Products and Processes.

The proposed compromise definition requires that the new or improved characteristics be technological in nature and expressly excludes research relating to management techniques and management-based changes in production processes. Thus, the definition not only substantially limits the ability of the food, apparel, and retail and wholesale sectors to claim the R&D credit, but also bars most service industries, including banking and other financial and insurance services, from claiming the credit.

Table 4 shows the amounts of credit claimed by taxpayers in these financial services sectors in 1981. 65/

Table 4

Compromise Definition: Impact of Management and Financial Services Limitation

Treasury Industry Code	Industry	1981 Credits Claimed (Thousands of $)
6210	Secur Brok, Dlrs & Floa	1,339
6299	Common Cntrt Brokers	662
6352	Life Ins, Stock Comp.	942
6353	Life Ins, Mutual Comp.	1,658
6356	Mutual Insurance	686
6359	Other Insurance Cos.	1,874
6411	Insurance Agents, Bro	1,018
Total		8,179

Under the present definition of R&D, the Revenue Service would have a difficult time in litigation successfully distinguishing financial services products from products generally. Moreover, it seems likely that the Revenue Service also would have difficulty successfully distinguishing services

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65/ These amounts likely include activities related to software development for internal use as well as to product development. As discussed below, the new restrictions in the revised definition on the eligibility of such software development for internal management use should eliminate the great bulk of such software from the credit.

from products for purposes of the present law definition: a taxpayer could successfully argue that a new technique developed for use in a service falls within the broad expanse of "invention or similar property" within the meaning of the existing section 174 regulations. The proposed compromise definition would foreclose these arguments.

Experimentation Process.

The compromise definition requires that to be eligible for the credit any product or process be developed by a true process of experimentation, including the development, testing, elimination, and refinement of alternatives in the face of uncertainty. Thus, the definition excludes a whole range of product development activities in which the specific alternative required to reach the desired result is readily discernible from the start and is readily attainable without the significant risk reflected in the process of testing and experimentation. In this respect, the definition of experimentation in the compromise provision -- which constitutes the first statutory definition of experimentation -- represents a substantial delimiting clarification over the present section 174 definition.

Under the proposed approach, a taxpayer will be required to establish that when he began the development of the product, he lacked the knowledge as to the manner in which to design the completed product, and that, because of such lack of knowledge, he had to utilize a series of experiments -- constructing design alternatives, testing those alternatives, and refining or discarding them -- in order to develop the product to operate in a usable manner. This element of the product will exclude, among other things, very modest changes to products or processes and new products or processes the design of which is reasonably obvious, such as new or improved products of the taxpayer essentially developed from publicly-available (or licensed) plans or specifications or from mere examination ("reverse engineering") of products of other companies. The existence of substantial experimentation indicates that the design of the product was neither obvious nor available through reverse engineering or other sources.

Unfortunately, the impact of this change on the revenue loss from the credit cannot be readily estimated from publicly-available data. The expenditures affected are not specific to any particular set of industries, but are likely to be a significant portion of total expenditures in most industries.

Clarified Exclusions Relating to Manufacturing Start-up Activities.

The proposed compromise R&D definition adds new exclusions from the category of qualified research for activities involving planning for commercial production (including "tooling up for commercial production," trial production runs, "trouble-shooting" of production equipment or processes), activities from the beginning of commercial production (such as "debugging" of flaws in the new product or flaws from an existing product as part of a routine model year change), mere duplication of another's product or process, and adaptation of an existing product to a specific customer's needs. While the revenue impact of these exclusions cannot readily be estimated, they will provide a clearer and more enforceable line which will foreclose a taxpayer from claiming the R&D credit with respect to activities which no longer constitute product development but instead are part of the initial stages of commercial production or which constitute mere copying of a product already on the market or mere tinkering with an existing product of the taxpayer.

In addition, the compromise definition makes clear that the development of a new or improved product will not necessarily cause to qualify for the credit the costs relating to production process necessary to manufacture that product. Rather, the taxpayer must apply all of the requirements of the definition of qualified R&D to the production process itself and demonstrates that the production process itself is technologically new or improved (and not subject to any of the exclusions from the definition of qualified R&D).

Internal Use Software.

Finally, the proposed compromise definition affects one of the primary types of expenditure areas for which the R&D credit has been claimed to date -- the development of software. While much innovative software is developed for sale in the highly competitive computer marketplace, expenditures are also incurred by companies to develop software in much more routine circumstances for their internal use. For example, most larger companies in the United States have internal software development staffs, the function of which is to develop and maintain software for various internal management purposes (e.g., inventory control or payroll and accounting). In many cases the development of this type of software is not innovative and benefits no one other than the developer.

Under present law, the R&D credit rules can be interpreted to make no distinction between the type of software sold or otherwise transferred to customers as a product -- which the market generally requires to be innovative -- and internal use software which can and is developed as a routine matter. The experience with the R&D credit to date demonstrates that companies in many industries are claiming the credit with respect to their internal use software development activities. In particular, the consulting, accounting, and financial services industries appear to have claimed a substantial amount of credit for the development of internal use software. According to the 1981 Treasury tax data, the total of these amounts for the part-year 1981 may be as much as $35-40 million, or about 6 percent of the total 1981 R&D credits claimed. Additionally, we believe that companies in a variety of other industries have claimed at least small amounts of credit -- which can aggregate to a significant amount -- for internal use software that is of a routine nature.

The proposed compromise definition provides that software separately developed by or on behalf of the taxpayer specifically for the internal use of the taxpayer (other than in R&D or a production process), such as use in providing accounting, management consulting, or other business services, will not qualify for the credit, except where such internal use software surmounts a substantial threshold of innovation. This provision as to internal use software, particularly when combined with this new requirement of technological invention, and the exclusion for management techniques should substantially reduce the amount of credit claimed by the financial and service sectors. It will also significantly reduce the amount of credit claimed in other sectors for software developed for internal use in general and administrative (G&A) activities.

Revenue Impact of Proposed Definition

The five specific areas described above in which the revised definition of R&D in the Senate-passed legislation narrows the present law definition will create some revenue increases which relate to identifiable industries and additional increases which cannot be so identified. If the total credit claimed in these areas by the identifiable industries were disallowed under the bill, the impact in 1981 would have been as shown in Table 5.

Table 5

Overall Impact of Compromise Definition

	1981 Credits Claimed (Thousands of $)
Functional Improvements Limitation	17,234
Financial Services Exclusion	8,179
Internal Use Software Exclusion	38,392
Total	63,805

This amount is 10 percent of total credits claimed for 1981. If that amount is projected to fiscal years 1985-1987 the revenue impact would be as follows:

	1985 66/	1986	1987	Total 1985-87
Revenue Increase from Narrow Definition	45	102	120	267

Admittedly, no one can be certain that all of this revenue which has been identified would be gained under the proposed R&D definition -- or that none of it would be saved under present law. However, it is clear that under the proposed approach significant additional revenues will also be gained from companies in industries or amounts which cannot be readily identified (e.g., style changes in consumer products, management techniques, readily discernible product designs and internal use software). It is likely that these latter amounts will be sufficiently large in magnitude to justify a revenue increase from the narrower definition at least the size of that set forth above.

66/ Assumes a January 1, 1985 effective date for the new definition.

THE R&D CREDIT AND HIGH TECHNOLOGY TAX BURDENS

Even with the impact of the R&D credit, recent studies by the Congressional Joint Committee on Taxation 67/, the publication Tax Notes 68/, and industry 69/ demonstrate that high technology industries bear a corporate income tax burden that is disproportionately high relative to U.S. industry generally. For example, the Joint Committee analysis indicates that average effective tax rates on U.S. income for U.S. electronics companies in 1981 were 50 percent higher than the average effective tax rates of U.S. companies generally. Moreover, the Joint Committee study for 1982 indicates that, as the 1981 Act became more fully effective, this disparity in effective tax rates grew. The study concludes that overall effective corporate tax rates on U.S. income declined in 1982. However, at the same time, effective tax rates for the high technology electronics industry have remained high. Thus, in 1982 effective tax rates in the high technology electronics

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67/ Staff of the Joint Committee on Taxation, Study of 1982 Effective Tax Rates of Selected Large U.S. Corporations, November 14, 1983.

68/ "Effective Corporate Tax Rates in 1981," A Special Supplement, Tax Notes, April 1982.

69/ High Technology Tax Policies for the 1980's, supra, p. 16-21.

industry were as much as 60 percent higher than the effective tax rates of U.S. industry generally.

A study by 20 companies from the high technology electronics industry 70/ established that if the R&D credit had not been enacted, the effective tax rates in the high technology electronics industry would have been 10 to 20 percent higher than their already disproportionately high levels. Thus, allowing the R&D credit to lapse after 1985 would exacerbate the disparity already present between high technology industries and capital intensive industries with long-lived equipment that benefited greatly from ACRS.

High technology industries stand prepared to bear a reasonable share of the federal corporate income tax burden. But as the Joint Committee's analysis indicates that the high technology electronics industry at least is already paying more than its fair share. The extension of the R&D credit, would thus merely continue the existence of an effective tax incentive and avoid any worsening of the substantial disparity that already exists between high technology tax burdens and those of U.S. industries in general.

70/ High Technology Tax Policies for the 1980's, supra.

CONCLUSION: AN EXTENSION OF THE CREDIT IS NEEDED NOW

AEA, CBEMA, SAMA and SIA strongly believe that the analysis described above leads to the conclusion that the R&D credit has been a sufficiently effective incentive to warrant its extension for a substantial period of time. The problem now is that the temporary nature of the R&D credit is distorting current R&D investment decisions. Many major R&D projects have a cycle of five years or more, with the greatest portion of cost coming toward the end of the cycle. For projects that would be undertaken now in response to the R&D credit, a substantial portion of the R&D costs incurred will be in years after 1985, the point at which the R&D credit currently is scheduled to lapse. Before undertaking a project and at each of the numerous milestones in the cycle of a project, a determination must be made whether the research effort is worthwhile.

If the tax incentive embodied in the R&D credit disappears, or if continuation of the credit seems problematic, a company's assessment of the financial risk will inevitably become more adverse and could lead to the reduced funding or termination of some projects. Even now, prudent managements may not count on the credit being extended past 1985. Having enacted the R&D credit and thereby encouraged companies to incur R&D risks that they otherwise might not have been willing to incur, Congress should not reverse this incentive by allowing the credit to lapse.

Appendix A

Country-By-Country Review Of R&D Incentives

Japan. Japanese corporations undertaking R&D in Japan may deduct their current R&D expenses in full in the year in which such expenses are incurred, with a carryover of unused deductions for up to five years. Capital expenditures for R&D purposes must be depreciated over their useful lives, generally from four to seven years for R&D equipment. These capital expenditures also may be eligible for special depreciation, which allows an additional deduction in the year in which the asset is acquired.

Japan has also had a tax credit for R&D expenditures since 1966. The current tax credit applies to current R&D expenditures as well as to depreciation and overhead expenses. The credit is equal to 20 percent of the excess of current R&D expenditures over the largest amount of such expenditures incurred in any single prior tax year since 1966. The credit does not reduce the R&D deductions otherwise available. Recent press reports indicate that the Japanese government is seriously considering proposals to raise the credit rate to 25 percent and to lower the credit base.

In addition, Japan allows a special deduction of up to 40 percent of corporate income for firms that derive some portion or all of their income from "overseas transactions in technical services." For example, Japanese corporations may deduct 28 percent of the income derived from the sale of technology abroad in the form of patents and know-how. Finally, firms which export products are allowed special reserves for the development of overseas markets.

South Korea. In South Korea, emerging as one of the strongest competitors of the U.S. high technology electronics industry in world markets, current expenditures for R&D may be deducted fully in the year in which they are incurred. While fixed assets used in R&D activity must be depreciated over their useful lives, companies in the electronics industry are eligible for the following additional depreciation allowances. Electronics companies, as one of Korea's targeted industries, are entitled to additional depreciation equal to 100 percent of normal depreciation. An investment credit on the cost of machinery and equipment (3 percent if imported; 5 percent if domestic) can be taken instead of the special additional depreciation allowance. A Korean corporation establishing R&D facilities is allowed either a one-time special depreciation allowance of 90 percent in the first year or a tax credit equal to 8 or 10 percent of the cost of the invested assets. A corporation investing in the further development of research results originated by certain research institutions may take either a one-time additional depreciation allowance of 50 percent of the invested assets or an investment tax credit of 6 or 10 percent. A corporation in the electronics industry also may take a tax credit equal to 10 percent of technology development and training expenses actually incurred, such as compensation paid to researchers, engineers, or research institutions. Finally, a Korean enterprise can set aside and claim as a deduction a special reserve for technology development in the greater amount of 1 percent of total revenue for the taxable year or 20 percent of taxable income. For the high technology-intensive industries, such as the semiconductor and computer industries. the deductible reserve can be up to the greater of 1.5 percent of revenue or 30 percent of taxable income.

Taiwan. In Taiwan, another strong competitor of the U.S. electronics industry, current expenditures on R&D are deductible in the year in which they are incurred. Any equipment used in R&D that has a useful life in excess of two years must be depreciated. However, R&D equipment is eligible for accelerated depreciation, and equipment with a useful life of ten years or less may be depreciated within one-half of its actual useful life. In addition, machinery or equipment purchased by a technology-intensive enterprise is eligible for an investment tax credit of 15 percent in the case of domestically-produced equipment and 10 percent of the acquisition cost in the case of imported equipment. Finally, Taiwanese technology-intensive industries are eligible for a special reduced corporate income tax rate of 22 percent.

United Kingdom. In the United Kingdom, current expenditures on R&D are fully deductible in the year in which they are incurred. In addition, capital expenditures incurred in R&D activities, including investments in machinery, equipment, and buildings used for research, are fully allowable as a deduction in the year in which such expenditures are incurred. Unused deductions may be carried forward for a period of up to five years. In addition, the British Government provides a system of direct grants for R&D projects.

West Germany. The Federal Republic of Germany provides for the deduction of current R&D expenditures from taxable income in the year in which they are incurred. While capital expenditures on R&D generally must be depreciated over the economic life of the assets, accelerated depreciation of R&D assets at rates of up to 50 percent over the first five years are permitted with respect to personal property. In addition, Germany provides a 20 percent direct cash payment (termed an "investment premium") on the first $170,000 (DM 500,000) and 7.5 percent on the balance spent in any given year on depreciable assets (including real property) used for R&D purposes. This tax credit does not reduce the amount of the R&D deductions that otherwise are available.

France. French tax law provides for the full deduction of current R&D expenses in the year in which they are incurred. Until recently, buildings used solely for scientific and technical research were eligible for a special accelerated depreciation allowance under which 50 percent of the cost of the building was deductible in the year of acquisition, with the balance being depreciated over the remaining useful life of the asset. In 1983, this special depreciation allowance was replaced by a 25 percent incremental tax credit very similar in structure to the U.S. R&D credit. In addition, France has adopted a generally-applicable system of accelerated depreciation in the first year of service of the asset. Finally, France also maintains a system of cash grants for R&D under which companies creating or expanding scientific or technical research departments may be entitled to a (taxable) cash grant of 15 to 20 percent of the value of the expenditure made, up to a maximum of 25,000 francs per job created.

Canada. In Canada, immediate expensing for both current and capital expenditures for R&D purposes is allowed. Canada provides for an indefinite carryforward of excess R&D deductions. Canada also offers a 20% flat rate tax credit for R&D activities based on a firm's total R&D spending, including R&D expenditures. Canada's R&D credit is unique in reducing the R&D deductions correspondingly on a dollar-for-dollar basis. However, Canada also provides an additional allowance equal to 50 percent of R&D expenditures (both current and capital) which exceed a base period amount determined on the basis of the annual average of the preceding three years.

Appendix B

Regression Analysis of Company R&D Spending

To analyze the potential impact of the R&D credit on aggregate corporate R&D spending, a regression analyses were undertaken relating company R&D spending to changes in Gross National Product. Both measured in constant 1972 dollars.

The analyses attempt to predict changes in R&D based on changes in GNP. The results were quite good. As Table 1 shows, the R-squared is .975, and the other measures of goodness-of-fit are highly significant. But in the 1980's the fit is significantly less good. In 1981 through 1984 R&D is significantly higher than would be expected, given the level of GNP in those years. This result is shown by the level of the residual in Table 1 for 1981-1984. (The residual is both listed and plotted in Table 1.)

TABLE 1

```
SMPL    1958  -  1984
27 Observations
LS // Dependent Variable is RAD
Convergence achieved after 2 iterations
===================================================================
                   COEFFICIENT    STANDARD ERROR  T-STATISTIC
===================================================================

           C        13.214016        27.739648    0.4763584
          GNP        0.0084058        0.0034731     2.4202377
-------------------------------------------------------------------
       AR(1)         0.9756797        0.0495937     19.673466
-------------------------------------------------------------------
R-squared            0.990167      Mean of dependent var  11.97426
Adjusted R-squared   0.989348      S.D. of dependent var    4.546132
S.E. of regression   0.469204      Sum of squared resid     5.283647
Durbin-Watson stat   0.778668      F-statistic           1208.408
Log likelihood      -16.28987
===================================================================
       Residual Plot           obs    RESIDUAL   ACTUAL     FITTED
]        y    *    y         ^ 1958   -0.04259  5.49700    5.53959
]        y  * :    y         ^ 1959   -0.20684  5.96000    6.16684
]        y    *    y         ^ 1960    0.03075  6.44500    6.41425
]        y  * :    y         ^ 1961   -0.19041  6.73300    6.92341
]        y *  :    y         ^ 1962   -0.29063  7.12200    7.41263
]        y *  :    y         ^ 1963   -0.22844  7.47600    7.70444
]        y  * :    y         ^ 1964   -0.19576  7.95900    8.15476
]        y    *    y         ^ 1965   -0.04364  8.66700    8.71064
]        y    *    y         ^ 1966   -0.03309  9.40100    9.43409
]        y    :  * y         ^ 1967    0.22535  10.1440    9.91865
]        y   *:    y         ^ 1968   -0.07298  10.7450   10.8180
]        y    :*   y         ^ 1969    0.08767  11.3570   11.2693
]        y*   :    y         ^ 1970   -0.35769  11.2500   11.6077
]     *  y    :    y         ^ 1971   -0.73203  11.0970   11.8290
]        y*   :    y         ^ 1972   -0.37671  11.5350   11.9117
]        y    :  * y         ^ 1973    0.24406  12.3910   12.1469
]        y   *:    y         ^ 1974   -0.10978  12.7450   12.8548
]       *y    :    y         ^ 1975   -0.50602  12.3870   12.8930
]        y    *    y         ^ 1976   -0.04335  13.1750   13.2184
]        y *  :    y         ^ 1977   -0.23213  13.8090   14.0411
]        y    :*   y         ^ 1978    0.07899  14.7020   14.6230
]        y    :   *y         ^ 1979    0.38393  15.7310   15.3471
]        y    :    y     *   ^ 1980    1.10637  17.0600   15.9536
]        y    :    y  *      ^ 1981    0.57490  18.0870   17.5121
]        y    :    y      *  ^ 1982    1.32041  19.5000   18.1796
]        y    :    *         ^ 1983    0.40953  20.5000   20.0905
]        y    :   *y         ^ 1984    0.38925  21.8300   21.4408
```

The above regression analyses were taken one step further by adding a dummy variable to represent the existence of the R&D tax credit. The dummy variable was set at 0.5 in 1981 and 1.0 in 1982, 1983, and 1984. This analysis produced a coefficient for the "credit" variable of about 3.46, meaning that the existence of the credit under this analysis can be determined to add $3.46 billion in 1972 dollars per year to industrial R&D spending (see Table 2 below).

TABLE 2

```
SMPL    1958  -  1984
27 Observations
LS // Dependent Variable is RAD
Convergence achieved after 4 iterations
=========================================================================
                  COEFFICIENT      STANDARD ERROR   T-STATISTIC
=========================================================================
       C          -3.2116525        0.6075587       -5.2861600
      GNP          0.0129137        0.0005481       23.560597
     CREDIT        3.4591308        0.4472881        7.7335635
-------------------------------------------------------------------------
      AR(1)        0.4184747        0.2138446        1.9569100
=========================================================================
R-squared                0.993994     Mean of dependent var    11.97426
Adjusted R-squared       0.993210     S.D. of dependent var     4.546132
S.E. of regression       0.374596     Sum of squared resid      3.227418
Durbin-Watson stat       1.773496     F-statistic            1268.798
Log likelihood          -9.635253
=========================================================================
```

This amount translated into current dollars would be approximately $7.7 billion. In other words, under this analysis the R&D credit is determined to cause an annual increase in R&D of nearly $8 billion.

When more years of observation are available, it is certainly possible that these numbers would be determined to vary significantly. Of course, the additional years of observation may also provide a basis for determining that other factors, not included in the above equation, contributed in part to the large growth in R&D in 1981 through 1984. Nonetheless, at this point in time the analyses set forth above are quite consistent with the theory that the credit has been an effective incentive.

Table 3 below sets forth the basic data used in this analysis. The GNP figures are from the Bureau of Economic Analysis, and the aggregate R&D figures come from the National Science Foundation. The industry-by-industry figures come from annual Business Week surveys and were used because they give more industry data than NSF sources. They are fairly consistent with, but slightly different from, the NSF data.

TABLE 3

RAD = Company spending on research and development, 1972 dollars

CHRAD = Percentage change in RAD

GNP = Gross national product, 1972 dollars

RADI = "R&D intensity" RAD/GNP

obs	RAD	CHRAD	GNP	RADI
1958	5.497000	5.105166	680.9000	0.008073
1959	5.960000	8.422772	721.7000	0.008258
1960	6.445000	8.137586	737.2000	0.008743
1961	6.733000	4.468575	756.6000	0.008899
1962	7.122000	5.777520	800.3000	0.008899
1963	7.476000	4.970509	832.5000	0.008980
1964	7.959000	6.460678	876.4000	0.009081
1965	8.667000	8.895586	929.3000	0.009326
1966	9.401000	8.468907	984.8000	0.009546
1967	10.14400	7.903415	1011.400	0.010030
1968	10.74500	5.924683	1058.100	0.010155
1969	11.35700	5.695677	1087.600	0.010442
1970	11.25000	-0.942153	1085.600	0.010363
1971	11.09700	-1.359999	1122.400	0.009887
1972	11.53500	3.947010	1185.900	0.009727
1973	12.39100	7.420893	1225.000	0.010115
1974	12.74500	2.856913	1248.000	0.010212
1975	12.38700	-2.808943	1233.900	0.010039
1976	13.17500	6.361509	1300.400	0.010131
1977	13.80900	4.812143	1371.700	0.010067
1978	14.70200	6.466794	1436.900	0.009793
1979	15.73100	6.999050	1483.000	0.010608
1980	17.06000	8.448284	1480.700	0.011522
1981	18.08700	6.019932	1509.600	0.011981
1982	19.50000	7.812242	1498.000	0.013017
1983	20.50000	5.128205	1550.000	0.013226
1984	21.83000	6.487804	1645.300	0.013268

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Chairman RANGEL. Mr. Miller?

STATEMENT OF MICHAEL I. MILLER, VICE PRESIDENT AND TREASURER, GOULD INC.

Mr. MILLER. Mr. Chairman, I am Michael Miller, and I am vice president and treasurer of Gould Inc., a $1.3 billion electronics manufacturer based in Rolling Meadows, IL. Before I proceed, I would like to thank this distinguished subcommittee for the opportunity to express my views, and the views of Gould, on research and development tax incentives.

Gould produces highly engineered, state-of-the-art goods. Consequently, by the very nature of our research intensive business, technological advancement is essential. In fact, a significant commitment to R&D in terms of both time and money is fundamental to Gould's ability to open and enlarge its markets.

As all of you know, product development in high tech areas has been proceeding at a breakneck pace. Gould is no exception—fully two-thirds of our current products can be classified as new; that is, they were not even in existence 4 years ago. Gould's R&D figures themselves tell the story—1983 R&D spending was $155 million, or about 11.7 percent of sales.

But research spending is important not only to Gould, but to our entire country. We feel that two major benefits accrue from research spending on a national level: one, the ability of American companies to compete in worldwide markets is enhanced ultimately leading to more jobs in the United States; and two, productivity is improved, thereby leading to higher levels of real wages and a higher standard of living for the American work force.

For generations, the United States has been recognized as the world's technological leader. However, the record of technical innovation during the 1970's suggests that this lead has been eroded. Only half of the chief technical officers at major U.S. corporations believe America has been maintaining its technological lead over foreign competition, according to a recent study by the consulting firm of Heidrick and Struggles.

These executives also felt insufficient R&D spending has been a major cause of low U.S. productivity and opined that the economic climate could support more R&D spending. Their premise that R&D is essential to productivity growth in the U.S. economy is not without support. A recent independent study by the Machinery & Allied Products Institute estimates that as much as 10 percent of our productivity slowdown during the 1960's was attributable to reduced R&D spending.

The threat that imports pose to domestic industry is especially ominous because imports enjoy substantial competitive advantages due in large part to direct subsidization. Our international competitors have established government policies aimed directly at promoting high-technology growth. Consequently, during the decade of the 1970's the amount of R&D funding by our key foreign competitors increased at a significantly greater rate than the United States.

The next question is whether the R&D credit actually spurs such spending. There is evidence suggesting that the answer is "yes". One survey conducted last year indicated that, for those companies utilizing the credit, R&D expenditures increased an average of 38 percent in the 1981-82 timeframe, over the pre R&D credit period of time.

Standard and Poor's reported that domestic electronics companies during the severe recession of 1981-82 did not curtail R&D spending despite lower sales and earnings and severely strained capital budgets. This marked a departure from business practice during prior recessions where R&D cutbacks generally occurred, likewise a McGraw-Hill survey showed that there has actually been a significant increase in R&D spending. R&D expenditures increased nationally by 16 percent in 1981, 8.4 percent in 1982, and an estimated 8.2 percent in 1983.

An important reason for the continued strength in R&D spending during this recessionary period, according to a National Science Foundation survey, is that, despite the high degree of economic uncertainty, lower profit levels, and higher interest rates, corporate R&D personnel were able to persuade management to protect R&D activities from internal corporate budget cuts during the economic downturn because of the more favorable tax treatment such projects receive under the credit, as compared with other discretionary company expenditures. For example, by comparison, during these same three years, capital spending on plant and equipment increased only 8.7 percent in 1981, and then decreased in 1982 and 1983.

We think such statistics are indicative of the fact that American business leadership has become acutely aware of this credit and, consequently, that the priority of R&D, in competition for limited corporate funds, has increased. At Gould, for example, the results of all business divisions are measured on an after tax earnings basis. Thus, management at all levels is aware of the tax consequences of the conduct of R&D, and I can assure this subcommittee that the existence of the tax credit has increased the amount of resources at Gould which have been dedicated to research.

We believe Congress should amend current law to make the R&D credit permanent. Most high-technology companies plan their research activities on a 3-to-5 year cycle, or even longer. At Gould, business plans are developed on a 5-year basis. The 1985 sunset may already be impairing the effectiveness of this incentive mechanism since the business planning horizon today typically extends beyond 1985.

Admittedly, making the R&D tax credit permanent will result in a short-term loss of revenue to the Treasury. But this subcommittee should view R&D expenditures as an investment in the future. A modest short-term loss is being exchanged for a potentially robust long-term gain with increased employment, enhanced productivity and competitiveness, a reduced trade deficit and, ultimately, an expanded tax base.

Thank you again for allowing me to express my opinions on this vital subject.

Chairman RANGEL. Thank you, Mr. Miller.

[The prepared statement and supplemental material follow:]

STATEMENT OF MICHAEL I. MILLER, VICE PRESIDENT AND TREASURER, GOULD INC.

My name is Michael I. Miller, and I am Vice President and Treasurer of Gould Inc., a $1.3 billion electronics manufacturer based in Rolling Meadows, Illinois. Before I proceed, I would like to thank this distinguished Subcommittee for the opportunity to express my views, and the views of Gould, on research and development tax incentives.

Some background information on our corporation provides reasons for our intense interest in R&D. Gould develops, manufacturers, and markets electronic systems, products, and components on a worldwide basis. Specifically, our business serves six markets:

High-performance 32-bit minicomputers and related software products;

Computer-integrated manufacturing equipment such as dedicated industrial computers, man-machine interace devices, and local area networks;

Test and measurement instruments, primarily logic analyzers, oscilloscopes, and oscillographic recorders;

Medical instrumentation, especially for blood pressure measurement and cardiopulmonary diagnosis;

Defense systems, which include undersea weapons, anti-submarine warfare surveillance systems, communications, avionics, and training simulation systems; and

Electronic components and materials, including semiconductors.

As is readily apparent from our product lines, Gould produces highly engineered, state-of-the-art goods. Consequently, by the very nature of our research-intensive business, technological advancement is essential. In fact, a significant commitment to R&D in terms of both time and money is fundamental to Gould's ability to open and enlarge its markets. As all of you know, product development in "high tech" areas has been proceeding at a breakneck pace. Gould is no exception—fully two-thirds of our current products can be classified as "new"; that is, they were not even in existence four years ago. Gould's R&D figures themselves tell the story— 1983 R&D spending was $155 million, or about 11.7% of sales. For 1984, R&D expenditures should approximate $175 million.

The point we would most like to make today is that research spending is important not only to Gould, but also to our entire country. We feel that two major benefits accrue from research spending on a national level:

(1) The ability of American companies to compete in worldwide markets is enhanced, ultimately leading to more jobs in the United Sates; and

(2) Productivity is improved, thereby leading to higher levels of real wages and a higher standard of living for the American work force.

The critical necessity for a strong national program of encouraging research spending becomes more obvious when the facts, some of which are cause for concern, are examined. The United States has been immersed in the world of "high tech" for several years and, in many areas, has been an innovator and influential leader. However, the history of worldwide technological developments during the 1970s suggests that this lead has been eroded. Only half of the chief technical officers at major U.S. corporations believe American has been maintaining its technological lead over foreign competition, according to a recent study by the consulting firm of Heidrick and Struggles. These executives also felt insufficient R&D spending has been a major cause of low U.S. productivity and opined that the economic climate could support more R&D spending. Their premise that R&D is essential to productivity growth in the U.S. economy is not without support. A recent independent study by the Machinery & Allied Products Institute estimates that as much at 10 percent of our productivity slowdown during the 1960s was attributable to reduced R&D spending.

The threat that imports pose to domestic industry is especially ominious because imports enjoy substantial competitive advantages due in large part to direct subsidization. Our international competitors have established government policies aimed directly at promoting high-technology growth. Japan, for example, provides companies with R&D loans not required to be paid back unless such R&D activity produces a revenue-generating product. Japan's Small Business Agency also recently announced plans to create four subsidizing systems centering around R&D activity, whereunder half the cost incurred by Japan's businesses engaged in various high-tech R&D projects would be financed. The French and Italian governments are likewise creating research assistance funds to provide qualifying companies with long-term, low-interest funds. Germany, on the other hand, provides premiums against the cost of investment in assets used for R&D purposes.

It is not surprising, then, that since 1964, the amount of R&D funding by our key competitors has increased at a significantly more rapid rate than the United States.

Real growth of R&D expenditures between 1970 and 1979 was approximately 15 percent for the U.S., 80 percent for Japan, 45 percent for West Germany, and 30 percent for France. When military R&D subtracted from the totals, the United States has been outspent on civilian R&D by these three major industrial competitors.

If this Subcommittee accepts the tenet that increased research spending is good for the U.S. economy and helps meet the goals of competitiveness and productivity, the next question is whether the R&D credit actually spurs such spending. There is supporting evidence for this premise. Last year, a consulting firm hired by the American Electronics Association conducted a survey which indicated that, for those companies utilizing the credit, R&D expenditures increased an average of 38 percent in 1981-1982 over the pre-R&D credit time frame. The conclusion was that, since this increase was attributable almost entirely to the credit and lost tax revenues would be quickly recouped because of future profits resulting from the R&D, the credit should be extended.

Other recent studies likewise support the premise that the R&D credit stimulates research. An electronics industry study prepared by Standard & Poor's reported that domestic companies during the severe recession of 1981-1982 did not curtail R&D spending despite lower sales and earnings and severely strained capital budgets. This marked a departure from business practice during prior recessions where R&D cutbacks generally occurred. Likewise, a McGraw-Hill survey showed that, despite the afore-mentioned recession, and the fact that the credit was only partially phased in during 1981-1982, there has actually been a significant increase in R&D spending. R&D expenditures increased nationally by 16 percent in 1981, 8.4 percent in 1982, and an estimated 8.2 percent in 1983. An important reason for the continued strength in R&D spending during this recessionary period, according to a National Science Foundation survey, is that, despite the high degree of economic uncertainty, lower profit levels, and higher interest rates, corporate R&D personnel were able to persuade management to protect R&D activities from internal corporate budget cuts during the economic downturn because of the more favorable tax treatment such projects receive under the credit, as compared with other discretionary company expenditures. For example, by comparison, during these same three years, capital spending on plant and equipment increased only 8.7 percent in 1981, and then decreased 1.2 percent and 1.3 percent in 1982 and 1983, respectively.

We think such statistics are indicative of the fact that American business leadership has become acutely aware of this credit and, consequently, that the priority of R&D, in competition for limited corporate funds, has increased. At Gould, for example, the results of all business divisions are measure on an after-tax earnings basis. Thus, management at all levels is aware of the tax consequences of the conduct of R&D, and I can assure this Committee that the existence of the tax credit has tended to increase the amount of resources at Gould which are dedicated to research.

The Government, too, has been influenced by these vital concerns. When Congress introduced the research tax credit provision in the Economic Recovery Tax Act of 1981, it was to help reverse a more than decade-long decline in domestic R&D spending. The Senate Finance Committee Report on the Act stated that the purpose of this tax credit was to help overcome the reluctance of business "to allocate scarce investment funds for uncertain rewards" of research projects. Congress recognized that while U.S. firms were spending a smaller percentage of gross national product on R&D, such spending by our foreign competitors was on the rise. It was thus hoped that this provision would foster research spending on the same scale as had occurred in other countries, especially Japan.

It is also notable that the Treasury itself recently testified in favor of a limited extension of the R&D credit at a hearing held by the Senate Finance Subcommittee on Taxation and Debt Management. John E. Chapoton, the Assistant Treasury Secretary for Tax Policy, told the Subcommittee that Treasury supported a three-year extension in order to enable taxpayers to plan their R&D activities. He further noted that, to the extent the market fails to reward businesses adequately for innovative research, businesses undertake less than optimal levels of R&D.

There is an immediate negative consequence associated with a failure to make this credit permanent but, rather, allowing it to disappear, as scheduled, at the end of 1985. Most high-technology companies plan their research activities on a 3-5 year cycle, or more. At Gould, for example, business plans are developed on a five-year basis. Therefore, the current expiration date is already a significant factor in making decisions on resource allocation for corporate research. Obviously, for some projects undertaken and in progress in response to the R&D credit, a substantial portion of such costs will be incurred in years after the credit is currently scheduled to lapse.

Admittedly, making the R&D tax credit permanent will result in a short-term loss of revenue to the Treasury. But this Subcommittee should view R&D expenditures as an investment in the future. A modest short-term loss is being exchanged for a potentially robust long-term gain with increased employment, enhanced productivity and competitiveness, a reduced trade deficit and, ultimately, an expanded tax base. In enacting the R&D credit, Congress pointed to the fundamental relationship between R&D activities and economic competitiveness in world markets. These considerations continue to exist today and, indeed, with the rising costs of even more sophisticated high-technology projects and intensified foreign competition, the need for such an incentive will continue to grow in importance.

Lastly, a firm's ability to develop and apply new products and technology to obtain a favorable competitive position is critical. For example, a timing edge in introducing a new product can often provide a company with a cost advantage over competitors. Accordingly, U.S. high-technology companies are locked in a continuous, intensive struggle with foreign competitors to bring new or improved products and processes to the marketplace as soon as possible. Not only will failure to extend the R&D credit eliminate a valuable incentive for important research activities, it will also mean that high-technology companies will have suffered another tax increase. Allowing the credit to lapse would exacerbate the present tax disparity between such companies and capital-intensive industries that have clearly benefited from the accelerated cost writeoff system enacted as part of the 1981 tax act.

Thank you again for allowing me to express my opinions on this vital subject.

QUESTIONS PROPOSED BY MR. RANGEL AND THE RESPONSES OF GOULD, INC.

(1) Whether your firm and/or association members claimed the research tax credit. If so, (a) for what year(s), and (b) in what amount(s).

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available, (a) the specific product or experimental activity that would not have been undertaken; (b) whether such activities would have been deferred to the future or never undertaken, and (c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

GOULD INC.,
Rolling Meadows, IL, November 8, 1984.

Mr. ED CZADOWSKI,
Winston & Strawn,
One First National Plaza, Chicago, IL

DEAR ED: In response to your inquiry:

1. a and b: 1981—2,213,399 (Gould), 394,964,000 (AMI); 1982—7,648,466; 1983—6,992,640; and 1984—3,205,000 (projected).

2. R&D related to all Gould businesses and would be a mixture of applied research, product improvements and new product development. We do not have a mechanism to identify exact amounts spent in each area.

3. R&D efforts impact all of Gould's products (brochure enclosed).

4. a, b and c: Each year, Gould determines how much it will be able to spend on R&D based upon its financial and performance goals. Without the credit there would certainly have been less funds available for investment in R&D. Undoubtedly, projects would have been defered. However, given the magnitude of the credit, there more than likely would have been technologies that we could not have afforded to pursue.

5. Cannot give specific answer to this question. One might guess that certain areas of pursuit in our central laboratories would not have been addressed without tax credits such as III–V materials.

6. We would have reported the same amounts.

7. Knowing that the tax credit is available would make the budgeting and planning for long term research a more viable and productive process. Knowing that there is a very tangible financial incentive to continue to invest in R&D even during economic downturns would guarantee long term commitment. One of the worst things that can happen in long term research is "starts" and "stops" based upon budgeting ups and downs. In fact, if you have "starts" and "stops" you will never have long term R&D.

In this regard, the tax credit is a very strong catalyst in making long term R&D research in this country more productive.

8. First, it would be very difficult to get any group of people to agree on a precise definition of basic and applied research versus development that would cover all the industries in our country. However, if a definition could be developed, this would have a negative effect in our company. The reason for all of our R&D efforts is the development of innovative new products. If the incentive of a tax credit does not carry through to product development, then there is no incentive for greater investment in basic or applied research. Also, if this tax credit is not available at the development level, then this effort might well have to be reduced, based upon available funds. If such a reduction occured then the transfer of technology from our central research center to operating divisions would become very difficult.

Should you have any questions, please contact my office.

Sincerely,

R. Jessee Begley, *Vice President,*
Finance and Administration,
Technology and Product Planning.

Chairman Rangel. Mr. Bryan, representing the New England Council.

STATEMENT OF L. THOMAS BRYAN, JR., CHAIRMAN, COMMITTEE ON CAPITAL AVAILABILITY FOR RESEARCH AND DEVELOPMENT, NEW ENGLAND COUNCIL, INC.

Mr. Bryan. Mr. Chairman, I am Tom Bryan, and professionally I am in charge of high tech lending at the Bank of Boston, which is one of the major banks in the country lending to the high tech industries.

I have submitted my remarks, and would like to deviate from them, if I may.

The New England Council is made up of 1,300 businesses and universities in the 6 States of New England, very few of whom are high tech companies. But the reason why the New England Council is strongly in support of this legislation is because it has had two very principal benefits to New England, and we think to the Nation as a whole. The benefits to our high tech industries has to be obvious from the testimony that you have heard today, and I would rather concentrate on the benefits to the other industries in New England who are users of the products, systems, and services that the high technology industries produce.

Our publishing industry, which is one of the major industries in New England, has seen tremendous benefits in productivity as a result of a substantial number of new innovations in computerized publication products that have been made available to it during the last 3 to 5 years from the high tech industries.

Our New England utilities have made increasing use of computerized systems to control the distribution of electricity and their costs, which are becoming increasingly a problem for New England.

And our service industries have made tremendous benefits in productivity as a result of the advent of cheaper, more productive computing capability. New England is primarily a service industry area, very much like your own district. We are primarily engaged in the financial services area, consulting and services of that sort, which make very, very heavy use of computerized systems and productivity instruments. As a result of this, our general level of employment has increased substantially, and we think that this is true for the Nation as a whole.

If you look at the last decade or so, from roughly 1965 to 1984, our adult population in America has increased 38 percent. But employment grew in terms of new jobs by 45 percent. The bulk of those new jobs did not come from Government, they did not come from large corporations. They came from small innovative businesses and medium-sized businesses who are taking advantage of the increased productivity tools to become more competitive and have better growth rates than the rest of the economy.

And New England is heavily populated with industries of this sort. From the most basic industries to the most esoteric industries, we are primarily a small business area. And we feel that our economy, which has changed drastically from one which had a higher level of unemployment than the national levels to one which now has a lower level of unemployment, is a result not of merely the presence of high technology industries, but by being able to take advantage of the productivity enhancements that these industries have provided our basis industries.

I would like to suggest that you and I, Mr. Chairman, share several very important reasons why we can't afford not to support this bill. You and I both live in major urban centers, you in New York and myself in Boston. These centers have several things in common. The first and most important one is that we have added substantial increases in jobs. Boston has added 50,000 jobs in the last 8 years or so. And I believe if I read the newspapers correctly that New York has seen somewhat of a similar success. Most of these jobs have come in the service industries, particularly in the financial services industries, whose productivity has been enhanced by utilizing the cheaper computing capability that is available to that industry.

We also share another thing. We are both intellectual centers. There are 350,000 college students in the Boston area. We have about 10 or 15 major universities. New York is the same. These universities are given largely by research and development. And to the degree to which private spending is motivated to be oriented and allocated to our universities, we are going to increase the teaching capability of these universities. So we are both interested in that.

And finally, in New England, the third largest employer is the medical industry. I believe that in New York, which is an equally important medical center, as is Boston, your industry must also be a major employer. This industry is under heavy pressure now from Congress, and it is appropriate to cut their costs. And there are only two ways they can do that. They can either reduce their staff, or they can increase their productivity. It is very important that that industry in particular be a rapid beneficiary of the computing and other instrumentation tools that the high technology industries are producing, that they have these as quickly as possible in order that the people who live in your district and the people who live in my neighborhood, many of whom are employees of these important industries, continue to have their jobs.

I think that there are a lot of reasons why this bill needs to be supported. I simply wanted to stress, even though my life is spent with the high tech industry as a financier thereof, that many of the most important beneficiaries of this legislation are not in the high tech industry, and that we should not really look at this as a high tech bill. It is a bill which is going to promote more research and development, which is going to have its real payback in adding jobs outside of the high tech industry and many of the industries that we think are very important, and many, like health, which need to be improved in terms of their productivity.

Thank you very much for having us, sir.

[The prepared statement follows:]

STATEMENT OF L. THOMAS BRYAN, JR., CHAIRMAN, COMMITTEE ON CAPITAL AVAILABILITY FOR RESEARCH AND DEVELOPMENT, NEW ENGLAND COUNCIL, INC.

Summary

1. The New England Council, Made Up Of 1200 Businesses And Educational Institutions In New England, Only A Minority Of Which Are High Technology Companies, Strongly Supports Passages Of S.2165, The High Technology Research and Scientific Education Act of 1983.

2. The High Technology Of Industries Have Played A Critical Role In New England's Recent Economic Development.

   a. High Technology Is The Largest Manufacturing Employer In New England.
   b. High Technology Is New England's Largest Source Of Exports.
   c. High Technology Is New England's Largest Capital Investor.

3. What's Good For New England Is Good For The Many Other High Technology Centers In The Nation.

4. How Do We Keep High Technology Growing? -- Support Research and Development and Education.

   a. Encourage Research And Development.
   b. Increase The Supply Of Superior Engineering And Scientific Talent.

5. S.2165 Meets High Technology's Needs.

   a. S.2165 Makes The R and D Tax Credit Permanent.
   b. S.2165 Treats Software R and D On A Parity With Hardware R and D.
   c. S.2165 Extends The Credit To Start Ups And New Businesses.
   d. S.2165 Encourages Increased R and D Expenditures By Industry Through Universities, Particularly For Basic Research.
   e. S.2165 Encourages Donations Of Much Needed Equipment To Universities.

6. The Most Important Beneficiary of S.2165, However, Will Not Be The High Technology Industry - It Will Be America's Basic Manufacturing And Service Industries.

STATEMENT

1. The New England Council, made up of 1200 businesses and educational institutions in New England, only a minority of which are high technology companies, strongly supports passages of S.2165, the High Technology Research and Scientific Education Act of 1983.

The New England Council, founded in 1925, has made passage of S.2165 its most important legislative priority for 1984. Only a minority of the New England Council's membership are participants in the high technology industries. Most of our 1200 members are engaged in basic manufacturing, energy, transportation, and a wide range of service industries. It is because high technology is so important to the future development of increased productivity in these industries, as well as making a direct contribution to the continued strength and growth of New England's economy, that the New England Council so strongly urges Congressional passage of S.2165 in 1984. We also urge its passage because we believe S.2165 will play a major role in the future growth and development of basic manufacturing and service industries as well as the high technology industries in other parts of our nation. We believe the negative impact on Federal deficits will be insignificant in comparison to the future benefit to the national economy.

2. The high technology industries have played a critical role in New England's recent economic development.

(a) High technology is the largest manufacturing employer in New England, having grown from 301,000 jobs in 1975 to 425,000 in 1981, an increase of 40% in six years. This has contributed substantially to a reversal of New England's traditional economic position. Before 1978, New England's unemployment rate was 1-2% higher than the nation's, but since 1978 it has been 1-2% lower than the nation's. Employment in some of New England's traditional industries, such as textiles, leather and shoe manufacture has declined, and has been replaced in large part by increased employment in the high technology industries. (See Chart 1) Relative to the nation, employment in the high technology industries has increased, while employment in most other sectors of manufacturing has declined. (See Chart 2).

(b) High technology is New England's largest source of exports, having provided 69% of New England's exports in 1980. Because high tech companies typically export 30-40% of sales to Europe, Canada and the Far East, we would expect high technology to continue to be our principal exporter in the future.

(c) High technology is New England's largest capital investor. In 1983, for the first time, high technology provided 51% of New England's capital spending. Bank of Boston's New England Capital Spending Survey projects a similar performance for 1984. The computer industry alone is expected to spend $1.1 billion of the projected $5.7 billion in 1984 capital spending in New England. From another perspective, 12%, or over $200 million, of the $1.8 billion of nationwide venture capital investment in 1982 occurred in Massachusetts and an estimated $300 million in all of New England. (43%, or $775 million, went to California)

3. What's good for New England is good for the ten other high technology centers in the nation. New England is only the second largest high technology center in the U.S. The largest is California--both in Silicon Valley and in Southern California. There are eight other important regional centers where high tech is either of significant importance or is growing rapidly:

1. The Mid Atlantic Region--
   New York, New Jersey, Pennsylvania, and the Washington DC area.
2. The Southeast Region--
   Florida, Georgia, North Carolina, and Alabama
3. Texas
4. Colorado
5. Washington
6. Oregon
7. Minnesota
8. Arizona

High Technology is clearly a national economic phenomenon. What has happened in New England and California will happen in each of these regional centers and in other regional centers as they emerge in the future.

4. How Do We Keep High Technology Growing?--Support Research and Development and Education.

Unlike many of our nation's troubled basic industries, which are seeking a broad array of government assistance, ranging from Federal loan banks, to import barriers to tax subsidies, the needs of the high technology industries are modest and essentially twofold:

(a) Encourage Research and Development. Most high technology companies spend 7% to 20% of sales on R & D. This constitutes their largest capital expense, usually several times their annual expenditure on plant and equipment. By comparison, the annual depreciation expense in the capital intensive industries like steel or aluminum is only 1.6% to 3.6% of sales.

(b) Increase the Supply of Superior Engineering and Scientific Talent. The real assets of a high technology company do not appear on its balance sheet. They are its technology and its management, the two most critical assets for innovation and growth. This means that the future development of our high technology is directly linked to a continuing flow of superior engineering and scientific talent--the minds that will conceive and develop the innovations of the future. Our universities are the producers of these minds. For this reason, the high technology industries have greatly accelerated their support of, and work with, universities during the past several years. A broad range of innovative programs ranging from joint venture R and D contracts, to equipment donations and scholarship funds have been actively supported by the industry. Congress recognized this trend in the tax legislation of 1981 by providing new incentives in the form of the R & D tax credit and increased deductions for equipment donations, thus encouraging further support of our nation's critically valuable scientific education establishment by industry.

5. S.2165 Meets High Technology's Needs. S.2165 meets most of the above needs.

(a) S.2165 makes the R & D tax credit permanent. Congress has provided permanent tax incentives to incent industry, including the capital intensive industries, to invest in new plant and equipment through accelerated depreciation rules and investment tax credits. These do not apply to R and D expenses, however. To encourage increased capital spending on R and D by the high technology industries, Congress introduced the R and D tax credit in 1981. We believe that it has had a very positive effect in accelerating the pace of R and D expenditure, which increased nationally by 16% in 1981, 8.4% in 1982, and an estimated 8.2% in 1983. By comparison, during the recession years of 1981, 1982 an 1983, capital spending on plant and equipment increased only 8.7% and decreased 1.2% and 1.3% respectively. Its expiration in 1985 means that these incentives to incremental R&D investment will disappear. By making the R&D tax credit permanent, through S.2165, Congress will put this credit on a parity with the investment tax credit, which will enable high technology management to incorporate it as a permanent capital cost reduction in its long term R&D planning. This is important because R and D is not a single year expenditure - it takes many years to complete most R and D projects. Passage of S.2165 will mean that R and D investment should continue to increase at rates in excess of both capital spending and inflation - a critical need if our economy is to retain its worldwide technological competitive edge.

(b) S.2165 treats software R and D on a parity with hardware R and D. This clarifies the existing law, which the Internal Revenue Service in its proposed regulations of 1983 construed to impose more restrictive tests for software R and D than for hardware R and D to qualify for the credit. Software R and D must be treated on a parity with hardware R and D. Nearly 60% of the cost and 27% of the sale value of a computer system today is attributable to software. Most computer manufacturers devote about one third of their R and D expenditures to software development. A substantial portion of the capital investment of a new computer company - somewhere between 25 and 50% - must be devoted to software development. The software business is a major business expected to grow from $8 billion in 1983 to $30 billion in 1988 or from 27% of the value of 1983 computer hardware to 50% of its value in 1988. Software is, and will continue to be, a major part of New England's high technology industry, which has created such well known software programs as Visicalc and Lotus 1-2-3.

(c) S.2165 extends the credit to start ups and new businesses. Under existing law the taxpayer must be "carrying on" a business to qualify for the R and D credit. This excludes both start up companies and new businesses of existing companies. Start ups have been the backbone of the development of the high technology industry in New England and in most other high technology centers. DEC, Data General, Prime and Wang, were all start up companies fifteen to twenty years ago. Today they account for nearly $8 billion in sales. The R and D credit can play a very significant role in reducing this cost of capital for a startup thereby providing additional incentives for enterpreneurs and investors to invest in new high technology enterprises. In 1972 Wang was a $36 million, slow growth producer of calculators, when it introduced its first word processor. Today it is a $1.8 billion leader in word processing and office automation employing over 16,000 worldwide. Existing law would not allow the credit for the similar development of a new product where it constitutes a whole new business for an enterprise. S.2165 corrects both of these defects.

(d) S.2165 encourages increased R and D expenditures by industry through universities, particularly for basic research. Congress should aggressively encourage industry to do more research through university because we get double value for each dollar so spent: the R and D and increased cash flow through the university sector to strengthen the scientific and engineering teaching infrastructure. Research dollars, be they government or private, fund a substantial portion of the costs of the post graduate, doctoral and professorial staff that teach the courses and run the labs which are so essential to future development of the superior engineering and scientific talent required by the high technology industry.

(e) S.2165 encourages donations of much needed equipment to universities. Congress took positive action to encourage the much needed re-equipping of America's university laboratories in 1981 by expanding the scope of the deduction allowable for equipment donations. S.2165 carries this two critical steps further. It allows the deduction for equipment donated to be used in scientific education, as well as research. It also allows the deduction to apply to software and maintenance contracts. This means industry will be incented to make donations of teaching as well as research equipment. S.2165 will also solve a critical problem for many of the donee universities which cannot afford to purchase the software needed for this equipment or to pay for maintenance, as both of these supplementary but essential elements to an instrumentation or computer system will now qualify as deductible donations.

6. The most important beneficiary of S.2165, however, will not be the high technology industry - it will be America's basic manufacturing and service industries. The principal objective of all high technology companies is to provide end users of their products with increased productivity. Any high technology company that does not accomplish this will fail very quickly. High technology is of value, therefore, only to the degree to which it enhances productivity in other sectors of our economy, such as:

making manufacturing processes more efficient, of higher quality and more human, such as robotic welding machines for the auto industry;

enabling materials producers to reduce energy costs and improve production quality through process controls, as in the steel and aluminum industries;

enabling utilities to cut costs by improved monitoring and control of energy utilization throughout their systems;

enabling service industries to have cheaper and improved telephone and data communications to cut their selling and service costs;

enabling small business to have inexpensive, easy to run data processing systems to help them control and reduce costs of production or service;

enabling Federal, state and local governments to control and reduce the cost of delivering services;

even enabling members of Congress to analyze information, communicate issues and inform their constituancees better, faster, cheaper.

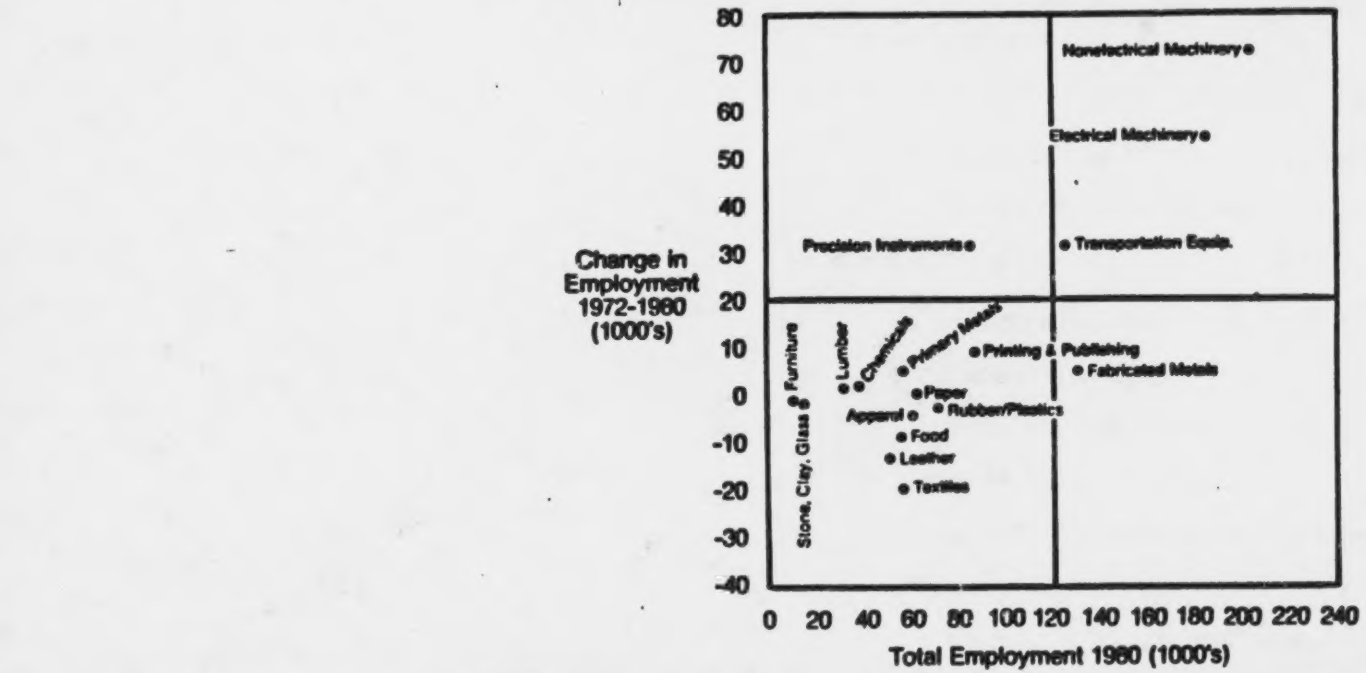
The products and services of high technology contribute to all of these, and in so doing will contribute substantially to that part of our economy which has generated the most new jobs in the past 20 years - the "low-tech" or "no-tech" mid-sized manufacturers ($25 million to $1 billion in sales) which grew four times as fast as the top Fortune 250 from 1975-1980. While America's adult population grew 38% from 129 million to 178 million between 1965 and 1984, the number of jobs grew by 45% to 103 million from 71 million. As Peter Drucker points out in his article in The Wall Street Journal (1/24/84) "Why America's Got So Many Jobs", these new jobs didn't come from government or big business:

> "Government stopped expanding employment in the early 1970s. Big business has been losing jobs since the early '70's. In the past five years alone the Fortune 500...have permanently lost around three million jobs. Nearly all job creation has been in small and medium-sized businesses, and practically all of it in entrepreneurial and innovative business... Even during the worst of the recent recession, when the Fortune 250 cut employment nearly 2% in one year, the midsized growth companies added one million jobs - or 1% of the country's employed labor force. And all that these companies have in common is that they are organized for systematic entrepreneurship and purposeful innovation."

While high tech has clearly contributed directly to New England's low unemployment rate, its greatest contribution has been indirect - to the small and medium sized businesses that are the backbone of New England's economy which have been the beneficial users of high tech's innovations in their businesses. What has happened in New England has happened elsewhere in the nation. By passing S.2165 Congress will assure that high technology's innovations, which are the basis for the most pervasive growth in our economy in the medium sized manufacturing and service businesses, will continue.

CHART 1

NEW ENGLAND MANUFACTURING EMPLOYMENT IN 1980 VS CHANGE IN EMPLOYMENT 1972-1980



The New England Council, Inc.

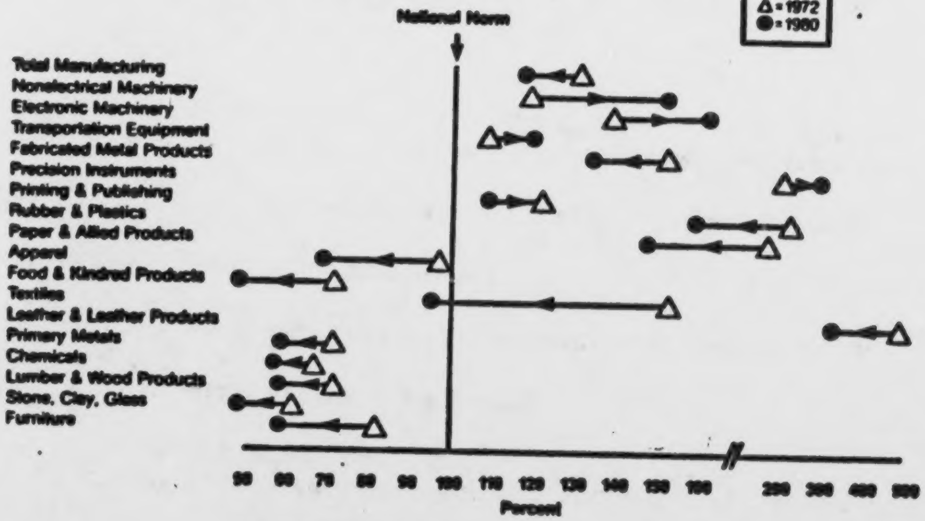
SOURCE: Department of Labor,
Bureau of Labor Statistics,
New England Regional Office

- FOUR MANUFACTURERS STAND OUT AS LARGE AND FAST GROWING:
  - —NON ELECTRICAL MACHINERY
    COMPUTERS, OFFICE MACHINES
  - —ELECTRICAL MACHINERY
    SEMICONDUCTORS, COMMUNICATION EQUIPMENT
  - —TRANSPORTATION EQUIPMENT
    SHIPS, AIRCRAFT ENGINES
  - —PRECISION INSTRUMENTS
    OPTICS, HEART MONITORS
- NONELECTRIC MACHINERY:
  - —EMPLOYED OVER 220,000 IN 1980
  - —HAD THE GREATEST INCREASE IN WORKERS, 70,000
- TRADITIONAL INDUSTRIES ARE STATIC OR LOSING JOBS:
  - —TEXTILES 20,000
  - —LEATHER 15,000

The New England Council, Inc.

CHART 2

PROPORTION OF NEW ENGLAND'S LABOR FORCE IN MANUFACTURING RELATIVE TO THE NATIONAL NORM (1972 AND 1980)



SOURCE: Data Resources, Inc.

The New England Council, Inc.

- IN 1972, 20% MORE OF NEW ENGLAND'S LABOR FORCE WAS IN MANUFACTURING RELATIVE TO THE U.S.
- BY 1980, NEW ENGLAND'S HIGH TECH SECTORS WERE CLAIMING INCREASING SHARES OF THE LABOR FORCE:

  —NONELECTRICAL MACHINERY

  50% GREATER LABOR FORCE SHARE THAN U.S. NORM

  —PRECISION INSTRUMENTS

  150% GREATER LABOR FORCE SHARE THAN U.S. NORM

- TRADITIONAL INDUSTRIES ARE EXPERIENCING RAPID DECLINE. MANY ALREADY HAVE SIGNIFICANTLY LOWER THAN AVERAGE SHARES OF THE LABOR FORCE.

The New England Council Inc.

Chairman **Rangel**. Thank you.

Mr. Rosenberg, from the National Coalition for Science & Technology.

STATEMENT OF MARC H. ROSENBERG, EXECUTIVE DIRECTOR, NATIONAL COALITION FOR SCIENCE & TECHNOLOGY

Mr. **Rosenberg**. Thank you, Mr. Chairman.

My name is Marc H. Rosenberg. I am the executive director of the National Coalition for Science & Technology.

We believe we are unique in the diversity of our membership, with both corporate and academic researchers joining together in one advocacy organization on behalf of creating a more favorable climate for the advancement of science and technology in the United States. We welcome this opportunity to share with your committee the insights we have gained from our special perspective.

Through its enactment of the R&D tax credit provision of the Economic Recovery Tax Act of 1981, Congress properly recognized the importance of research and development expenditures to our Nation's economic well-being and also acknowledged that the tax code could be used to encourage businesses to make additional outlays in this vital area. Creation of the special R&D tax credit was helpful to our national effort to maintain America's role as a world leader in scientific discovery and technological advancement.

The R&D tax credit, which allows corporations to claim a tax credit on 25 percent of their incremental increase in R&D expenditures over a base period, is due to expire at the end of 1985. Thus, it is appropriate to review that law at this time. In fact, it is regrettable that the question of extending the R&D tax credit is not already settled.

It is important to remember that most corporations view major R&D outlays almost as they would a capital expenditure. That is, relatively big R&D projects are planned several years in advance, and they take some time to execute. And they are funded at the expense of operating budget items which could be producing short-term profits for those corporations.

As you have heard from many witnesses already, major R&D projects that would begin in 1986 (after the current expiration date of the R&D tax credit) are already well along in the planning stage at many corporations, and budget decisions affecting those projects are being made right now. Thus, it is unfortunate that those decisions must be made in an atmosphere of uncertainty about the future of the tax credit.

Following this same line of thought, we note the difficulty of assessing the impact to date of the R&D tax credit. It was not enacted until 1981 and has been available only for 2 full calendar years since then. Most of the major new R&D expenditures made by private industry during this time period probably were planned before the new law was in place.

Given the law's scheduled expiration and the uncertainty over the exact nature of the credit if it is indeed extended, we cannot expect to see the full impact of the R&D tax credit. Congress must make a longer term commitment to the proposition that the Internal Revenue Code can be an effective instrument for stimulating scientific research and experimentation. If you want to influence what is essentially long-term behavior, we believe you have to take a long-term approach to the problem.

Neither the original 4½-year trial nor the 3-year extension proposed earlier this year by the Treasury Department is a long enough period of time to be meaningful in this context.

Mr. Chairman, the National Coalition for Science & Technology supports an extension of the R&D tax credit as we also endorse all of the major concepts contained in the legislation, H.R. 4475 and S. 2165, the main points of which were incorporated in the Senate version of the 1984 tax package. We were pleased that the Senate included those features in its legislation, and we are encouraged that roughly a third of the Members of the House of Representatives cosponsored the measure here. And we hope that you will act quickly on it in this committee.

Having said all that, though, I do wish to point out that there are several areas where we believe the proposed legislation would benefit from some modification. The following is a brief summary of our recommendations concerning the future of the R&D tax credit.

First, we believe the R&D tax credit should be permanently extended. Even with the administration's proposed extension of the credit to the end of 1988, we would not be seeing any major R&D project that was fully planned and executed with the certain knowledge of the tax credit being available. In order for society to obtain the full benefit of the incentive that could be provided by the credit, the law must span both the 3- to 5-year period required to plan a major R&D project and the years it will take to actually implement that project.

A 3-year extension, as I said, is too short a period. Perhaps 10 additional years would provide a sufficiently long test. But whatever figure is picked, it would be a wholly arbitrary one and would not necessarily coincide with all research that is contemplated. Consequently, we believe a permanent extension is the only logical course.

Second, we do believe that the definitions of qualifying R&D should be tightened. We appreciate the committee's concerns in this regard, and we do believe that the language included in the Senate-passed legislation is very helpful.

Third, we believe that certain behavioral research should be included in the definition of qualifying R&D. While NCST generally supports the more restrictive definition of "qualifying R&D" found in the pending legislation, there is one area where we feel that both that bill and current law should be eased up a bit, and that is in the ban on all social science research. We understand the concern that the legislation not be opened up to allow market surveys and similar sociological or demographic studies, and we agree on that point and note that efficiency surveys, market studies and so forth, are specifically proscribed by that legislation in another provision.

There are some fields of behavioral research, though, which may have direct relevance to technological advancement and which should be included in the list of qualifying research. For example, the subject of human factor engineering, also known as man-machine interaction, certainly is germane to efforts to increase productivity through greater automation in the workplace.

In another area, we have a great deal of research being conducted in the field of artificial intelligence systems now, and it would seem unreasonable to exclude applicable psychological or neurological research on how the mind actually works.

Fourth, we believe the R&D tax credit should be made available to some startup and joint venture enterprises. We heartily endorse this provision of the proposed legislation, although we think it should go further.

Fifth, we believe the tax credit should be made available to partnerships for passthrough to investors. Both current law and proposed changes deny the advantage of R&D tax credits to those investors in a partnership who are not themselves engaged in the business related to the subject of the research being conducted. We think that is a mistake.

Sixth, we recommend creating further incentives for corporations to fund basic research at institutions of higher education and welcome that provision in the pending legislation.

Seventh, we also support expanding the list of institutions qualified to receive basic research grants to include freestanding, nonprofit research facilities.

Eighth, we believe there should be further encouragement of the donation of state-of-the-art scientific equipment and related items to post-secondary schools. We applaud that provision of H.R. 4475, but would also like to see enhanced deductions for modern scientific equipment donated to secondary schools as well.

During the past few years we have had at least a half dozen studies proclaim the dismal state of math studies and science studies in the United States. We recognize human resources have been the major focus of attention, but most reports also have noted the critical absence of modern scientific equipment for most of our Nation's secondary schools. We believe encouraging smaller companies to give modern scientific equipment to local high schools and vocational training centers would help in that regard.

To reiterate, Mr. Chairman, the National Coalition for Science & Technology recommends the continuation of the enhanced tax credit for research and development, we endorse the broad outline of the proposed amendments to the R&D tax credit as embodied in H.R. 4475, and we ask you to consider the several changes we have recommended to improve the proposed legislation.

Thank you, Mr. Chairman.

[The prepared statement and supplemental letters follow:]

STATEMENT OF MARC H. ROSENBERG, EXECUTIVE DIRECTOR, NATIONAL COALITION FOR SCIENCE & TECHNOLOGY

Mr. Chairman, my name is Marc H. Rosenberg. I am the executive director of the National Coalition for Science and Technology. Our membership includes approximately 1,000 research scientists, educators, business people and engineers. We also count a number of high technology corporations and professional societies among our members.

We believe we are unique in the diversity of our membership, with both corporate and academic researchers joining together in one advocacy organization on behalf of creating a more favorable climate for the advancement of science and technology in the United States. We welcome this opportunity to share with your Committee the insights we have gained from our special perspective.

Through its enactment of the R&D tax credit provision of the Economic Recovery Tax Act of 1981, Congress properly recognized the importance of research and development expenditures to our nation's economic well being and also acknowledged that the tax code could be used to encourage businesses to make additional outlays in this vital area. Creation of the special R&D tax credit was helpful to our national effort to maintain America's role as a world leader in scientific discovery and technological advancement.

The R&D tax credit, which allows corporations to claim an extra tax credit on 25% of their incremental increase in R&D expenditures over a base period, is due to expire at the end of 1985. Thus, it is appropriate to review that law at this time. In fact, it is regrettable that the question of extending the R&D tax credit is not already settled.

It is important to remember that most corporations view major R&D outlays almost as they would a capital expenditure. That is, relatively big R&D projects are planned several years in advance, and they take some time to execute. And they are funded at the expense of operating budget items which could be producing short-term profits.

Major R&D projects that would begin in 1986 (after the current expiration date of the R&D tax credit) are already well along in the planning stage at many corporations, and budget decisions affecting those projects are being made right now. Thus, it is unfortunate that those decisions must be made in an atmosphere of uncertainty about the future of the tax credit.

Following this same line of thought, we note the difficulty of assessing the impact to date of the R&D tax credit. It was not enacted until 1981 and has been available only for two full calendar years since then. Most of the major new R&D expenditures made by private industry during this period probably were planned before the new law was in place.

In effect, we are looking at a feature of the tax code that so far has been rewarding people ex post facto for decisions they had already made. Given the law's scheduled expiration before the completion of current R&D planning/ execution cycles, and the uncertainty over the exact nature of the credit if it is extended, we can logically assume that the R&D tax credit will continue to be a reward rather than an incentive unless Congress makes a longer term commitment to the proposition that the Internal Revenue Code can be an effective instrument for stimulating scientific research and experimentation.

If you want to influence what is essentially long-term behavior, you have to take a long-term approach to the problem. Neither the original 4½-year trial nor the 3-year extension proposed earlier this year by the Treasury Department is a long enough period of time to be meaningful.

The major legislative proposal now pending concerning the extension of the R&D tax credit is the High Technology Research and Scientific Education Act, H.R. 4475 and S. 2165. In brief, that legislation would:

* make permanent the 25% incremental R&D tax credit;

* tighten the definition of qualifying R&D, emphasizing technologically based products and processes;

* make the credits available to some start-up and joint venture enterprises;

* create further incentives for corporate funding of basic research conducted at institutions of higher education; and

* encourage the contribution of state-of-the-art scientific equipment and related items to post-secondary schools.

Mr. Chairman, the National Coalition for Science and Technology supports an extension of the R&D tax credit, as it endorses all of the major concepts contained in the legislation outlined above. We were pleased that the Senate included these features in its version of the 1984 tax package, we are encouraged that roughly one third of the House of Representatives is cosponsoring the measure over here, and we hope that you will act quickly on it.

Having said all that, though, I wish to point out that there are several areas where we believe the proposed legislation would benefit from some modification. We believe the pending legislation should be amended to:

- make R&D tax credits available to investment partnerships;
- include certain behavioral/social science research in the list of qualified research activities; and
- allow enhanced deductions for donations of modern scientific equipment to secondary schools.

We are very conscious of the Committee's limited time and the great volume of material you must digest on this subject. Hence, the following is merely a summary of our thoughts on the key issues raised in this debate. We would be happy to provide you with more detailed information about any of these points.

1. The R&D tax credit should be permanently extended.

Even with the administration's proposed extension of the 25% incremental credit to the end of 1988, we would not be seeing any major R&D project that was fully planned and executed with the certain knowledge of the tax credit being available. In order for society to obtain the full benefit of the incentive that could be provided by the credit, the law must span both the three-to-five year period required to plan a major R&D project and the years it will take to implement that project.

Three years is too short a period. Four and a half years is too short a period. Maybe 10 additional years would provide a sufficiently long test. But whatever figure is picked, it would be wholly arbitrary and it would not necessarily coincide with all research contemplated. Consequently, we believe a permanent extension is the only logical course.

2. Tighten the definitions of qualifying R&D.

We appreciate the Committee's and the Treasury Department's concerns that the additional tax credit should not be available for expenditures which are not truly R&D in nature. The new definition of qualifying research provided in H.R. 4475 is helpful in this regard. Eliminating marketing-oriented R&D while focusing on fundamental improvements in products or processes provides a useful conceptual framework.

In reviewing the Treasury Department's previous testimony on this subject (Assistant Secretary John Chapoton's testimony before the Senate Finance Committee on February 24, 1984), we are troubled by this statement:

> Of the total number of companies in our [1981 tax return] sample that claimed [R&D tax] credits, over one-fourth have their principal line of business outside of manufacturing and utilities. These companies, mainly in the trade, service and financial sectors, claimed growth in qualified [research] from 1980 to 1981 of 91 percent. . . . These companies account for only about 8 percent of the total credits claimed. . . .

Hopefully, the more restrictive definition of qualifying research will limit the use of the credit for research not related to products or processes. However, we also should note the weakness of any analysis which equates the type of research conducted solely with the sponsor's principal line of business. In this day and age of conglomerate corporations, it is not unprecedented for aircraft manufacturers to own steel mills or for steel producers to own oil companies or for oil companies to own electric motor manufacturers, etc. In the absence of line-of-business reporting, aggregated data is not very enlightening.

3. Include certain behavioral research in the definition of qualifying R&D.

While NCST generally supports the more restrictive definition of qualifying R&D found in H.R. 4475, there is one area where we feel both that bill and current law should be eased up a bit. That is in the ban on all social science research.

We understand there is a concern that the legislation not be opened up to allow market surveys and similar sociological/demographic studies to be counted as qualifying research. We agree on that point and we note that efficiency surveys, market studies and so forth are specifically proscribed by another portion of the legislation.

There are some fields of behavioral research, though, which may have direct relevance to technological advancement and which should be included in the list of qualifying research. For instance, the subject of human factors engineering or man/machine interaction is germane to efforts to increase productivity through greater automation of the workplace. In another field, consider the application of basic psychological and neurological research to the development of artificial intelligence systems.

4. Make the R&D tax credit available to some start-up and joint venture enterprises.

We heartily endorse this provision of the proposed legislation, although we do recommend that it go further, as we note below.

The present law's requirement that the R&D tax credit be used only by a corporation in furtherance of its ongoing business clearly discriminates against start-up companies. As numerous studies have shown that small businesses, and especially newly formed small businesses, are among our nation's greatest resources in the struggle for technological innovation, it makes sense that we should do everything possible to nurture them.

At the other end of the scale, we also see relatively large joint ventures being formed in certain high technology industries. As we have testified before other Committees of the Congress, we believe these are useful and beneficial to our economy and also should be encouraged. Certainly, we should correct any feature of the tax code which discriminates against those who participate in them.

5. Make the tax credits available to partnerships for pass-through to investors.

Both the current law and the proposed changes contained in H.R. 4475 deny the advantage of R&D tax credits to those investors in a partnership who are not themselves engaged in business related to the subject of the research being conducted by the partnership. We think this is a mistake.

Evidently, the concern here is that the R&D tax credit not become a new form of tax shelter. Presumably, the argument is that wealthy investors should not be allowed to avoid their tax obligations by placing their money in partnerships which would yield a higher-than-normal tax offset because they are engaged in qualified research. Quite frankly, we wonder what is so terrible about that.

The Internal Revenue Code currently provides significantly leveraged tax advantages to those who invest in certain kinds of real estate development or who help finance oil and gas exploration or who engage in any number of other speculative investments. So long as that kind of legislatively induced incentive exists for investments in other areas, why should those seeking to raise funds for research and development be placed at a comparative disadvantage?

Similarly, we recommend dropping the provision in the proposed legislation which would deny the tax credit to those who are financing otherwise qualifying R&D for eventual licensing rather than in-house exploitation of the research product. Again, our concern is that this clearly is a disincentive to investors who might otherwise be helping to fund a research project. Conceivably, it may also be harmful to small research companies that have chosen not to make the heavy capital investments required for manufacturing and marketing but who wish instead to keep their focus primarily on research and innovation.

6. Create further incentives for corporations to fund basic research at institutions of higher education.

The current law contains certain provisions which allow corporations to count as qualifying R&D expenditures a portion of the funds they provide to colleges and universities to help underwrite basic research. H.R. 4475 would allow a larger portion of the funds to be counted and thus provides a stronger inducement for such expenditures. It also provides a more rational way to account for the large grants that are vital to undertaking major new projects.

We strongly endorse this proposal, with the further refinement noted below.

7. Expand the list of institutions qualified to receive basic research grants to include free-standing research facilities.

The current law specifies that corporate grants in support of basic research activities may be counted towards R&D tax credit formulations only if they are made to academic institutions of higher education. The proposed amendments contained in H.R. 4475 would expand the list of qualifying recipients to include non-profit research facilities which are not necessarily formally connected to any college or university. We believe this is very important, as a great deal of significant research activity is conducted at such nonaffiliated institutions, especially in the life sciences.

For the Committee's benefit, I would like to name just a few of these institutions which come immediately to mind. There is the Jackson Laboratory in Maine, the Sloan-Kettering Memorial Institute in New York, the Worcester Center for Experimental Biology in Massachusetts, the Wistar Institute in Pennsylvania, and more. We do not believe anything in the tax law should provide a disincentive for corporate underwriting of the research that is done at the many fine, independent research institutions such as these.

8. Further encourage the donation of state-of-the-art scientific equipment and related items to post-secondary schools.

The proposed legislation would provide a more favorable tax treatment for state-of-the-art scientific equipment (defined as being less than six months old if donated by the manufacturer or less than three years old if donated by a purchaser/user of the equipment, and in good working order in either case) given to universities, colleges, junior colleges and post-high school vocational schools. The proposed new legislation also would include computer software and equipment maintenance contracts in the category of qualifying items.

There is no question that many of our institutions of higher education are struggling to train our next generation of scientists and engineers with obsolescent equipment. Some of our brightest young scientists are going abroad to complete their educations, because the equipment available in some foreign schools is significantly more modern than that which is available to students in this country. The problem is especially acute in the very competitive fields of electrical engineering and biotechnology.

We believe that it would be quite helpful to amend the tax code to provide further incentives for corporations to donate new or almost-new equipment to academic institutions which would use them for teaching or research. This is by no means the comprehensive and systematic solution that this problem warrants, but it could be of substantial help in the interim.

9. Allow enhanced deductions for donations of modern scientific equipment to secondary schools, too.

During the past few years, we have had at least half a dozen national studies proclaim the dismal state of pre-college science and math education in the United States. While human resources have been a major focus of attention, most reports also have noted the critical absence of modern scientific equipment from most of our nation's secondary schools. We are talking about both the traditional academic programs were students prepare for continued education in college and those programs that prepare students for immediate entry into the workplace.

Today's world is one in which factory workers operate computer-controlled machines and where retail clerks take inventory on hand-held computers. Surveyors now take lasers into the field with them. A student planning to enter today's job market must be prepared to cope with the tools of today's world.

Similarly, students preparing to go on to more advanced studies should be familiar with the tools of modern research. Today's laboratories contaih far more than the simple test tubes, microscopes and slide rules of just a few years ago.

We believe the tax code should be revised not only to encourage donations by large corporations to major academic institutions but also to encourage smaller companies to give modern scientific instruments to local high schools and vocational training centers.

To reiterate, Mr. Chairman, the National Coalition for Science and Technology recommends the continuation of the enhanced tax credit for research and development. We endorse the broad outline of the proposed amendments to the R&D tax credit, H.R. 4475. And we ask you to consider the several changes we have recommended to improve the proposed legislation.

We urge you to expedite your consideration of the R&D tax credit and to take final action in time to allow enactment of new legislation before Congress adjourns. Whatever action you choose to take, the Committee should be mindful of the long lead time required for planning and implementation of major corporate research undertakings.

In closing, we call your attention to a comment made by Dr. George A. Keyworth, Science Advisor to the President, earlier this year. He said:

> Above all, I believe it's critical to be aware of the need for consistency in any policy for science. The planning cycles for the world of science and technology are far longer than the turnaround times in the political arena, and we all recognize that one of the most serious detriments to good science is what we might call roller-coaster funding.

NATIONAL COALITION FOR SCIENCE AND TECHNOLOGY
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Michael I. Yarymovych
LEGAL COUNSEL
Mark L. Rosenberg

August 15, 1984

Hon. Charles Rangel, Chairman
Subcommittee on Oversight
Committee on Ways and Means
1102 Longworth H.O.B.
Washington, D.C. 20515

Dear Mr. Rangel:

On August 3, I testified at the Oversight Subcommittee's hearing on tax incentives for research and development. With this letter, I wish to expand on the statement which I presented on behalf of the National Coalition for Science and Technology.

You will recall that we support the provision in H.R. 4475 which would provide more favorable tax treatment of grants given by corporations to colleges and universities to support basic research. We noted, however, that research done at free-standing, non-profit facilities which are not affiliated with academic institutions is equally deserving of inclusion in the list of qualifying expenditures.

We also testified in support of enhanced deductions for donations of state-of-the-art scientific equipment to academic institutions. We neglected to mention, and wish to add now, that we also believe equipment donated to independent research institutions should receive similar tax preference.

There is a common thread which runs through these recommendations. It is present also in our position that the R&D tax credit should be made more readily available to small and start-up businesses and to joint ventures and even to some investment groups.

The point is that this legislation embodies a national commitment to enhancing America's scientific research base and to increasing the amount of research that is done in this country. Presumably, this reflects the emerging consensus that substantial investment in R&D is to the long-term benefit of society. The use of tax expenditures represents a commendable reluctance on the part of Congress to dictate the details of corporate efforts in support of industrial research.

This being the case, the National Coalition for Science and Technology encourages you to eliminate artificial barriers to the free flow of these research dollars. Why should grants for basic research be channeled by the tax laws solely to academic institutions if non-academic facilities are capable of doing the same work? And why should investors in small research-oriented companies be denied the use of the R&D tax credit when shareholders in larger companies get the advantage of the law?

We believe that the R&D tax credit and related provisions are beneficial to the nation. But we feel they would be even more helpful if the benefits of the tax expenditures were available equally to all who are qualified to do the research. Thus, we conclude that any restrictions in the law ought to be placed on the definition of what constitutes qualifying research activities rather than on who actually does that work.

The National Coalition for Science and Technology applauds your panel for its interest in the issue of encouraging research and development and we urge you to proceed expeditiously with the renewal of the R&D tax credit.

Sincerely,

Marc H. Rosenberg
Executive Director

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BK / Vicki

September 17, 1984

Hon. Charles Rangel, Chairman
Subcommittee on Oversight
Committee on Ways and Means
1102 Longworth H.O.B.
Washington, D.C. 20515

Dear Mr. Chairman:

Last month, I testified on behalf of the National Coalition for Science and Technology at your subcommittee's hearings on tax incentives for industrial research and development. Subsequently, you sent us an inquiry (copy enclosed) with detailed questions about how the current R&D tax credit is being used by corporations.

Some of our institutional members are manufacturing companies which do a considerable amount of industrial R&D. We forwarded copies of your questionaire to them and asked them to send us whatever information they felt would be appropriate. As you know, we do not have direct access to any of the information you sought.

In response to your inquiry, we are sending the replies we received from some of the corporations that belong to the National Coalition for Science and Technology. Any additional responses which may straggle in after your deadline will also be forwarded to you.

I believe you will see that the enclosed materials help underscore two major points that were made in our original testimony. They are: 1) that any revision or extension of the R&D tax credit should take into account the fact that it often takes five, ten or more years for a major research project to move from the planning stage all the way through to completion; and 2) that the R&D tax credit currently is not as accessible as it should be to those companies which are exploring new product ideas or new ventures.

Again, we thank you for the opportunity to comment upon the pending R&D tax credit legislation, and we urge you and your colleagues to move expeditiously to resolve the fact of the R&D tax credit so that it can be factored into business plans for the coming years.

Sincerely,

M H R

Marc H. Rosenberg
Executive Director

So that the Subcommittee can more fully evaluate the impact and effect of the research tax credit, Congressman Rangel requests that each witness provide the following information by September 17, 1984:

(1) Whether your firm and/or association members claimed the research tax credit. If so,

  (a) for what year(s), and

  (b) in what amount(s)

(2) The specific types of research activities for which your firm claimed the credit and whether the research related to basic research, applied research, improvement of an existing product, or development of a new product.

(3) The final product or process to be affected or created.

(4) If the credit had not been available,

  (a) the specific product or experimental activity that would not have been undertaken,

  (b) whether such activities would have been deferred to the future or never undertaken, and

  (c) the resulting amount of reduction in overall research spending.

(5) The research and experimentation activity which was undertaken primarily because of the tax benefits available under the credit.

(6) The amount and types of expenditures reported as "qualified" expenditures in claiming the credit but not included as research costs in reports made to the SEC.

(7) If the credit is made permanent, how this would affect your firm's long-term research budgeting and planning.

(8) If the definition of qualified research expenditures is narrowed to include basic and applied research activities, but not development expenditures, how this would affect your firm's research activities.

THE UPJOHN COMPANY
KALAMAZOO, MICHIGAN 49001, U.S.A.

PHARMACEUTICAL RESEARCH
AND DEVELOPMENT
Office of
JACOB C. STUCKI, Ph.D.
Vice President
TELEPHONE (616) 385-7053

September 14, 1984

Marc H. Rosenberg
Executive Director
National Coalition for Science and Technology
Suite 319, NEA Building
1201 16th Street, N.W.
Washington, D.C. 20036

Dear Mr. Rosenberg:

In answer to the questions on R&D tax credits submitted by Chairman Charles Rangel of the Oversight Subcommittee of the Ways and Means Committee, The Upjohn Company offers the following answers:

1. 1981 - $2.8 million
   1982 - $5.8 million
   1983 - $6.7 million

2. Direct R&D expenditures in all the areas listed.

3. Primarily pharmaceutical projects and manufacturing processes.

4&5. The R&D tax credit is a significant economic incentive encouraging businesses to increase their financial commitment to research. R&D projects, however, are not generally undertaken solely on the basis of economic considerations of any single economic factor. The decision involves consideration of many operational, logistical, and financial factors. Therefore, an evaluation of the effectiveness of the R&D credit based on projects undertaken solely or primarily for tax benefit are rare and will not provide a meaningful measurement of the incentive's effectiveness. Rather, its effectiveness is better measured by the increase in R&D expenditures by U.S. business as a whole. Upjohn's R&D commitment has increased from 8.5% of sales for years prior to the credit (1978-80) to 11.5% in 1983. Such an evaluation should be made over a longer time frame than three years since, as NCST pointed out in its presentation, R&D projects generally have a long planning cycle.

6. We had no qualified research expenditures claimed under the R&D credit which were not also included as R&D for SEC reporting.

7&8. As indicated above, since economic factors are not the sole consideration in R&D planning, we can't estimate with any precision the impact of the credit's suspension on our Company's future R&D expenditures. We think the effectiveness of the credit as an incentive should be evaluated against its impact on overall business spending for R&D, and in view of the longer-term planning cycle, over a period of perhaps 5-10 years. Obviously, if the definition of qualified R&D is narrowed, the incentive and its impact will be constrained to those R&D areas covered in the revised definition.

I hope the information is of help to the NCST.

Sincerely yours,

Jacob C. Stucki

mgb

cc: A. H. Lincoln

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September 10, 1984

Mr. M. H. Rosenberg
Executive Director
National Coalition for Science and Technology
1201 16th Street, N.W., Suite 319
Washington, D.C. 20036

Dear Marc:

With reference to your letter dated August 21, 1984, Rockwell International's answers to questions on benefits of the R&D tax credit requested by Congressman Rangel are attached.

We have not derived substantive benefit from the R&D tax credit because of the rather rigid definition of "qualified" expenditures. Specifically, exclusion of the allowable cost portion of our independent research & development (IR&D) expenditures in the tax credit calculation prevents us from achieving a tax credit proportional to our increase in discretionary R&D spending.

In order to provide a true incentive to Rockwell International and other aerospace and defense contractors for increased R&D spending, we believe that allowable IR&D costs negotiated through advance agreements with the Government should be treated as qualified expenditures.

Sincerely,

M. I. Yarymovych

ROCKWELL INTERNATIONAL RESPONSE TO QUESTIONS ASKED BY CONGRESSMAN RANGEL

1) The only year that Rockwell claimed the research tax credit was in 1983. The amount of the credit was $1.759M.

2) This credit was claimed for a wide spectrum of research and development activities ranging from basic research through current product improvements and new product development.

3) See response to question (2).

4) The R&D tax credit has had no impact on Rockwell R&D expenditures and plans because of the restricted definition of qualifying expenditures.

5) None

6) None

7) The R&D tax credit as currently constituted would have negligible effect on Rockwell long-term research and budget planning. See response to question (4).

8) Narrowing the definition of qualified expenditures would not materially affect Rockwell research planning.

The Purdue Frederick Company

100 CONNECTICUT AVENUE, NORWALK, CONNECTICUT 06856 • TELEPHONE: (203) 853-0123—TELEX: 996450

August 31, 1984

Marc H. Rosenberg
Executive Director
National Coalition for Science
and Technology
Suite 319, NEA Building
1201 16th Street, N.W.
Washington, DC 20036

Dear Marc,

I am writing in response to your recent communication about the R&D Tax Credit Act which NCST would appear to support. Regrettably, I must inform you that I do not agree.

I am personally engaged in a number of technology related businesses, none of which have been able to benefit from the current law at all. The reasons are complex, but are primarily due to the complex rules which govern the calculation of basis. Even though in every one of these companies we are spending more in R&D in each successive period, we cannot claim the benefit. In other areas, where the R&D is for the development of new technologies in a new entity, the tax credit is unavailable because it is treated as start-up capitalization.

I for one would like to know just who is benefiting in this program. Based upon my experience, it is not those who one would expect.

Very truly yours,

Richard S. Sackler, M.D.
Vice-President,
Medical Department

ls

WANG LABORATORIES, INC.
ONE INDUSTRIAL AVENUE LOWELL, MA 01851 • TEL 617/459-5000, TWX 710-343-6769 TELEX 94-7421

PAUL GUZZI
VICE PRESIDENT

September 10, 1984

Mr. Marc H. Rosenberg
Executive Director
National Coalition for Science and Technology
Suite 319, NEA Building
1201 16th Street, N.W.
Washington, DC 20036

Dear Mr. Rosenberg:

Thank you for providing us with a copy of your testimony on behalf of NCST in support of extending and revamping the R & D tax credit. Your presentation was thorough and convincing.

We have reviewed the questionaire distributed by Congressman Rangel and have determined that because of the proprietary nature of the information requested, we will not submit a reply for the Oversight hearing record at this time. Nonetheless, we look forward to working with you and with members of your staff to make the case for this vital legislation.

Yours very truly,

Paul Guzzi

Paul Guzzi

PG/ms

Chairman RANGEL. Thank you.

Mr. Duncan.

Mr. DUNCAN. Thank you, Mr. Chairman. I want to thank the members of the panel. Testimony yesterday from Treasury and GAO indicated that part of the increase in R&E is attributable to taxpayers reclassifying a broad range of expenses as R&E just for purposes of claiming the tax credit. Would you care to respond to that allegation by the Treasury, anyone member of the panel?

Mr. HICKEY. I don't believe that is the case in the very large majority of the companies. We sign the tax return. We take that responsibility very seriously. We know that the tax return including the definition of items in the base percent as well as in the current percent is subject to audit, and I would be surprised if the situation you described existed in any more than a very small minority of small firms.

Chairman RANGEL. If the gentleman would yield?

Mr. DUNCAN. I will be glad to.

Chairman RANGEL. The Treasury wasn't talking about the question of fraud. They were talking about shifting the accounting system to take advantage of the credit. They certainly didn't mean to imply that it was illegal.

Mr. HICKEY. Of course, one of the basic tenets of accounting is consistency and that is also requried under the tax laws. The opinion that I would have would be that there is ample protection in the legislation and in the audit function.

Mr. BRYAN. Mr. Chairman, I work with some of the industry associates that have been working out the language in the Senate bill with the Treasury, and one of the important achievements we think in that bill is that a lot of the definitions were clarified.

Not only was the software problem overcome, but we also think that the whole area of research was narrowed to a more appropriate range. I clearly sympathize with both your and the Treasury's complaints about the infamous McDonalds hamburger. Those things certainly fall without the scope of an R&D tax credit. But at the same time one must not get too much into the notion of experimentation in the absolute sense.

Much of the productivity that we achieve here is generated by the gradual reworking of an idea and that chip which my colleague from Motorola held up has been a long process of tinkering with different concepts and ideas over time so that applied research is indeed a trial and error effort, which the legislation must account for. And it is really the heart of our taking basic research ideas and getting them out into useful products and that is really what we want in this legislation.

Mr. DUNCAN. I have no further questions, Mr. Chairman. Thank you.

Chairman RANGEL. I want to thank this distinguished panel for sharing its views with us and as I pointed out to other witnesses, we will allow the hearing record to remain open until September 17 in case there are some ideas that you have passed over that you would like to share with us. Thank you very much.

Our last panel is Steven C. Beering, president of Purdue, representing the National Association of State Universities and Land Grant Colleges; Dr. Stephen Kahne, dean of engineering, Polytechnic Institute of New York, representing the American Society for Engineering Education; Larry Sumney, executive director of the Semiconductor Research Corp., and Alan Kraut, deputy executive officer of the Office of National Policy Studies representing the American Psychological Association.

President Beering.

STATEMENT OF STEVEN C. BEERING, M.D., PRESIDENT, PURDUE UNIVERSITY, REPRESENTING THE ASSOCIATION OF AMERICAN UNIVERSITIES AND NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES

Dr. BEERING. Thank you very much, Mr. Chairman, members of the committee. I am Steve Beering, president of Purdue University and the Purdue Research Foundations. I am most grateful for the opportunity to testify with respect to the research and experimentation tax credit on behalf not only of Purdue, but also the Association of American Universities and the National Association of State Universities and Land Grant Colleges.

Chairman RANGEL. We have been looking forward to your testimony. Congressman John Myers has alerted us that you would be with us today. Thank you very much.

Dr. BEERING. Thank you. I am a fan of the congressional panels. We at Purdue are very much concerned with the issue which you are discussing today, because of our heavy involvement in industrially supported research.

Over the past 5 years, we have seen 140 companies come forward as cosponsors of research at our institution. This has involved a dollar volume exceeding $50 billion. It was of interest to me as I began to compare the statistics that the annualized figures have increased at a rate four times faster than comparable research dollars in other areas of our research enterprise.

At the moment, it exceeds $20 million a year in total research expenditure of $80 million. The companies that have been our partners, a veritable host of American business and industry, and it is also interesting that over the past 5 years, the number of dollars by individual companies has increased and there are now 10 that are participating at a level exceeding $1 million a year.

This steady increase can be temporarily connected to the existence of the tax credit. I want to hasten to add that the time has been too short to draw any reliable conclusions. We do feel, however, that at Purdue the presence of this industrial partnership has positioned us to compete successfully for a new State funding which has been made available, and is focused on economic development.

Our experience suggests that university-industry relationships evolving from research collaborative endeavors have a distinctive positive impact. On the university side our students and faculty are exposed to the needs and opportunities of industry, the real world if you will.

From the industry standpoint, instrumentation, laboratory facilities, human resources and so are made available at a fraction of the cost of their inhouse duplication. In addition, there is access to both graduate and undergraduate students and regrettably two senior faculty who became potential employees.

Society benefits from reducing the cost of research and enhancing the technology transfer process from laboratory to practical application. There seems to be a real telescoping of the timeframe here. The importance of this collaboration for the national welfare in general and the U.S. economic competitiveness in particular is fast approaching the status of conventional wisdom.

In your opinion structuring the Nation's tax laws fostering the industry-university relationships will yield long-term economic benefits, many-fold greater than their cost in tax revenue. I was impressed by the IBM testimony that the payroll taxes in themselves may actually make up for the potential tax revenue loss.

In other words, to maximize the impacts of tax credits on industrial supported university research, it would be wise to have the legislation establish a fixed pace against which credit-eligible research expenditures may be computed. The 1981 tax law provisions are such that initial incremental outlays by industries for university research become part of an escalating base which in turn forces an ever-increasing pattern of expenditures to trigger the tax credit.

This tends to encourage more applied research closely associated with short-term gain and immediate product development while offering far less incentive for basic research which typically involves long-term-level funding arrangements and the kind of expanded timeframe that makes for real lasting progress.

Senate bill 2164 would have leveraged $6 of industry investment in university basic research for each dollar of tax revenue. We hope that the Congress will see fit to enact legislation incorporating this kind of feature. By way of answering the questions, Mr. Chairman, that you have posed, I would like to comment on selected issues enumerated in your June 4, 1984, announcement for these hearings.

Issue 1: Should credit be made permanent? We honestly hope that tax credit provisions facilitating industrial responsorship or basic research at universities will be made long term. I realize that permanent is forever.

Issue 4: Should categories be broadened or narrowed? In general, we believe it would be helpful to focus on basic research, to define credit eligible expenditure categories broadly, and to emphasize long-term support.

Issue 6: Does the base period matter? We believe that a fixed base period for computing credit-eligible research expenditures is crucial; in other words, to provide research incentives. This could take the form of a 3-year period as specified in the existing tax law, except that said period, say 1981–83, would remain unchanged for succeeding tax years.

Issue 7: Should there be both tax credit and tax deductions? To the extent that availability of both the credit and tax deduction for the same research expenditures would operate synergistically to encourage industry support of university research, the university community would be in favor of it.

Issue 10: Has the present law been effective? As I have intimated earlier, the present law has not been on the books long enough to allow us to assemble compelling statistics on its effect. However, the trends are evident and they are forward and positive. We believe that a revised law incorporating the features we have outlined could have a profoundly positive effect on the volume of university research sponsored by the industrial sector and consequently on the economic vitality and international competitiveness of our Nation.

Mr. Chairman, members, on behalf of the organizations I represent, I thank you for the opportunity to comment on these issues.

[The prepared statement follows:]

STATEMENT OF STEVEN C. BEERING, M.D., PRESIDENT, PURDUE UNIVERSITY, ON BEHALF OF THE ASSOCIATION OF AMERICAN UNIVERSITIES AND NATIONAL ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES

Mr. Chairman, I am Steven C. Beering, President of Purdue University. I am most grateful for the opportunity to testify with respect to the Research and Experimentation Tax Credit on behalf of my institution and the National Association of State Universities and Land-Grant Colleges, and the Association of American Universities. We, at Purdue, are very much concerned with this issue as a consequence of our heavy involvement in industrially supported research: approximately $20 million of our more than $80 million in research expenditures for Fiscal Year 1982-'83 were derived from industrial sponsors.

Our experience at Purdue suggests that industry-university relationships evolving from collaborative research endeavors have a distinctly positive impact on both communities. On the unversity side, students and faculty are exposed to industry needs and perspectives. Faculty become sensitized to applications of their research results, and, thus, become more knowledgeable partners in the technology transfer process. Graduate students participating in industrial projects gain knowledge and insight which make the transition form campus to job easier, and shorten the time to full productivity. From the industry standpoint, instrumentation, laboratory facilities and human resources are made available at a small fraction of the cost of their in-house duplication. Access to both graduate and undergraduate students as potential employees also is an important factor.

Let me state at the outset that the university community I represent is most grateful for congressional efforts aimed at enhancing collaborative research between industry and our nation's universities. The importance of this collaboration for the national welfare in general, and U.S. economic competitiveness in particular, is fast approaching the status of conventional wisdom. In our opinion, stucturing the nation's tax laws to foster industry-university relationships will yield long term economic benefits many-fold greater than their cost in tax revenue.

In order to maximaize the impact of tax credits on industrial support of university research, it is essential that new legislation establish a fixed base against which credit-eligible research expenditures may be computed. The 1981 Tax Law provisions, while admirable in concept, are such that initial incremental outlays by industry for university research become part of an escalating base which, in turn, forces an ever-increasing pattern of expenditures to trigger the tax credit. This tends to encourage more applied research closely associated with product development, while offering far less incentive for basic research at universities, which typically involves long-term, level funding arrangements.

It is recognized that establishing a fixed base for calculating credit-eligible research expenditures has a down side in the form of tax revenue loss. In our opinion, this should be viewed in the context of the federal government's historical commitment to the support of basic research at universities. (Some 60-65% of the annual cost of this research is borne by the Federal Government.) This commitment results in part from the understandable tendency of industry to emphasize applied research with relatively shorter-term and less risky impact on corporate profits. It has long been agreed that the Federal commitment is in the national interest because it is essential to the stable growth of the domestic economy and the continuing improvement of our quality of life, and finally because university basic research provides invaluable support and training for graduate students who represent the keystone of future technological innovation in our nation. In this context, the fact that Senate Bill S. 2164 would have leveraged $6.00 of industry investment in university basic research for each $1.00 of tax revenue contributed by the government can only be understood to be not a revenue loss, or tax expenditure, but a highly productive and critically necessary capitol investment We hope that the Congress will see fit to enact legislation incorporating such a non incremental and permanent, i.e. unsunsetted, basic research tax credit.

By way of summation and emphasis, Mr. Chairman, I have the following comments on selected issues enumerated in your June 4, 1984, announcement for these hearings.

ISSUE	COMMENTS
1	We earnestly hope that tax credit provisions facilitating industrial sponsorship of basic research at universities will be made permanent.
4	In general, it would be helpful to define credit-eligible research expenditure categories which, to the greatest extent possible, emphasize the development of a knowledge base essential for long term industrial innovation.

6 A fixed base period for computing credit-eligible research expenditures is crucial for providing basic research incentives. This could take the form of a three-year period as specified in the 1981 Tax Law, except that said period (e.g. 1981-'83) would remain unchanged for succeeding tax years.

7 To the extent that the availability of both a credit and tax deduction for the same research expenditures would operate synergistically to encourage industry support of university research, the university community would be in favor of it.

The present law was not in effect long enough to allow one to assemble compelling statistics on its impact. Because ERDA rules were not published until 1982, because the credit, under law, will sunset in 1985, and because industry research normally runs on 3-5 year cycles (depending on the relative commitment to basic research), it can be said that the incentive scarcely existed. But it is, in concept, at least a commendable step in the right direction. We believe that a revised law incorporating the features I have outlined could have a profoundly positive effect on the volume of university research sponsored by the industrial sector.

While the other issues cited in the announcement are clearly important, they can be most suitably addressed by representatives of the industry and government communities.

In conclusion, Mr. Chairman, I wish to reiterate my appreciation for the opportunity to present these views on this issue. The university community commends and supports you in these most important deliberations.

Mr. PICKLE [presiding]. Thank you, sir, very much. I believe the next gentleman is Dr. Stephen Kahne. Dr. Kahne is dean of engineering at Polytechnic Institute of New York.

If you will proceed, sir.

STATEMENT OF STEPHEN KAHNE, DEAN OF ENGINEERING, POLYTECHNIC INSTITUTE OF NEW YORK, REPRESENTING AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Mr. KAHNE. Mr. Chairman, my name is Stephen Kahne. I appreciate the opportunity to testify. I am dean of engineering at the Polytechnic Institute of New York, which was created in 1973 from the merger of the Polytechnic Institute of Brooklyn and the Engineering College of New York University. We are a large technological university and annually we graduate one of the largest classes in the country of students with the degree of master of science in various engineering disciplines. The Polytechnic is a private institution with 70 percent of its income derived from tuition, a high percentage by national standards.

I am also testifying on behalf of the American Society for Engineering Education, which is composed of 9,500 individual members and 550 institutional members, consisting of schools with accredited engineering and engineering technology programs and more than 100 major corporate employers of engineers and engineering technologists.

I would like to confine my remarks today, Mr. Chairman, to those parts of the 1981 R&D tax credit and those parts of the Senate-pased extension of that credit which promote closer research relationships between universities and industry. The 1981 tax credit acknowledged the growing importance of that relationship by enacting a special credit for increased basic research expenditures by corporations at universities. While a number of factors might account for increased expenditures by corporations for university research since 1981, it is nevertheless true that at my own institution, industrial support for research has increased from 4 percent of the total in 1980 to early 30 percent in 1983.

Much of this was due to increased equipment donations. There are a number of reasons for this increased interdependence. The first is simply that it is necessary. There may have been a time when universities could restrict themselves to basic research and corporations only to applied research, but we, both universities and corporations, are seeing more clearly all the time that products and services which can hold their own in a competitive world market are increasingly dependent on fundamental scientific understanding.

As products grow more complex the processes which create them require greater involvement with the fundamental properties of the materials and more basic understanding of the systems in which they are being used. This is particularly true, for example, in the fields of microelectronics and biotechnology.

A second area in which our circumstances are demanding greater interdependence is the education of the scientific and technical personnel which both enterprises depend upon. Industry looks toward the university as a training ground for future scientists and engineers. The university increasingly looks toward industry as a source of the research grants which make that training possible. These are not new ideas, nor were they new in 1981.

The incremental tax credit which was enacted in 1981 was designed primarily to encourage companies to increase their level of expenditures for research and development each year. The credit for university research was designed on the same incremental pattern. As an instrument to encourage university research, it could be improved. Basic research, which is what universities typically emphasize, is characterized by the fact that it requires relatively level support over a fairly long period of time.

A nonincremental credit, such as that passed by the Senate, would establish a higher level of collaboration between university and industry scientists. In recognition of the long-term nature of the research cycle, from basic research to application to development and finally to market, such a credit should not carry a sunset date.

I would now like to turn to the equipment donation provisions contained in the Senate-passed version of the bill. Under a special rule added by ERA, corporations are allowed an augmented charitable deduction for donations of newly manufactured scientific equipment or apparatus to a college or university for research use in the physical or biological sciences and engineering.

I must admit that I don't like describing it as a "charitable" deduction; the concept of enlightened self-interest seems to describe it much better. At Polytechnic we see signs that the 1981 legislation has had its intended effect. There has been a noticeable increase in industrial support since the law passed. Despite this increase, however, the condition of laboratories in our school and at most others in the United States is lamentable, lagging far behind the state of the corporate laboratories we are training staff to fill.

Laboratory experience is central to the education of scientists and engineers. Because of the deterioration of university laboratories over the last decade, university laboratory experience has become much less representative of modern science and engineering. Young scientists are thus increasingly being denied the opportunity to work at the cutting edge of scientific inquiry. There is also evidence that as laboratory equipment wears out, universities are being forced to redesign their curricula to place less emphasis on direct laboratory experience.

Clearly this is a direction that is undesirable. Extending the deduction to used equipment and to service agreements to maintain this equipment would provide some much-needed improvement in this intolerable situation. A 1985 R&D tax credit law certainly will not solve the problem of America's deteriorating research infrastructure in universities, but it would provide an incentive for additional corporate support.

Mr. Chairman, the health, welfare, and defense of our society are directly related to the strength and vigor of our science and engineering research capability. My testimony has addressed only one part of this capability—the vital link between universities and industry. There are many reasons why this link is central to the success of the whole enterprise of encouraging research and development.

Support of university research today means support for the research effort of tomorrow, with all that implies for tomorrow's productivity and our ability to compete internationally. An extended R&D credit, a nonincremental credit for univeristy basic research, and an expansion of the equipment donation provisions would further strengthen our critical research enterprise which the 1981 act set out to encourage. Thank you very, Mr. Chairman.

Mr. PICKLE. We thank you, Dr. Kahne, very much.

Now, Mr. Larry Sumney.

STATEMENT OF LARRY A. SUMNEY, EXECUTIVE DIRECTOR, SEMICONDUCTOR RESEARCH CORP.

Mr. SUMNEY. Thank you very much. Good afternoon. My name is Larry Sumney, executive director, SRC, Semiconductor Research Corp.

Mr. PICKLE. Where are you located?

Mr. SUMNEY. North Carolina.

I welcome this opportunity to appear before the subcommittee today to voice SRC's strong support of the tax credit for research and development activities and to urge this subcommittee's serious consideration of proposals to broaden and improve the present tax credit as it applies to corporate payments to our Nation's colleges and universities for basic research.

The SRC is a nonprofit organization whose 31 members are companies of diverse size that are semiconductor manufacturers, semiconductor users, and suppliers to the semiconductor industry. SRC was formed to promote basic research by universities in the scientific fields that underlie semiconductor technology, by combining companies' funds and contracting with universities throughout the country for the creation of major research centers and for specific research projects.

The SRC's current annual university research budget exceeds $12.5 million. With these funds the SRC has been able to fund over 50 proposals from over 170 received from 52 universities. I have attached to my written statement a list of the 34 universities where SRC-sponsored research presently is being carried out. Many of these are located in the States that are represented by members of the subcommittee.

The R&D credit was an important factor in the decision to proceed with the creation of the SRC, both because of the positive environment for R&D and university basic research that was created by the tax credit, and also because of the SRC's ability to use the credit as a positive mechanism to attract corporate members willing to fund the university basic research activity.

Continued growth in semiconductor technology and in the closely related fields of computer and telecommunications technology will be possible only if corresponding advances are made in the scientific fields which underlie it. Yet this crucial need for expanded basic research comes at a time when basic research in this Nation has been suffering from a decline.

Moreover, as the result of the dramatic surge in technological progress in our industry over the past 15 years, the costs to our universities in performing basic research necessary for continuing technological progress and for educating future scientists and engineers have increased most rapidly. Accordingly, additional funding by individual companies and cooperative mechanisms such as the SRC, I believe, is absolutely essential to obtain expanded levels of university basic research.

The response of SRC member companies under the existing R&D tax credit incentive has been very substantial. However, we strongly believe that great potential exists for a broad expansion of SRC's funding of university research, if the tax incentives for corporate support of such research are enhanced.

The present R&D credit treats corporate funding of university basic research essentially the same as the costs of in-house product development. Thus the present credit provides no particular incentive for a corporation to shift research projects from in-house product development to university basic research. It seems that a clear need exists for a differentially larger incentive if corporate taxpayers are to be persuaded to apply a larger part of their corporate R&D budgets to fund university basic research.

The R&D, as originally adopted by the Ways and Means Committee in 1981, included a differentially larger incentive for university research by providing a flat rate tax credit of 25 percent for corporate funding of university basic research. However, this flat rate credit was not in the so-called Hansen-Conable substitute that ultimately was adopted by the full House and hence the tax credit supported by the Ways and Means Committee did not actually become law.

SRC would strongly support such a flat rate credit approach to corporate funding of university research. We believe that the 1984 Senate-passed R&D legislation also adopts an appropriate approach by providing a nonincremental credit for corporate payments to universities for basic research that are in excess of a fixed maintenance of effort level. This maintenance of effort minimum insures that the new nonincremental university research credit would be available only to corporations that increased their funding of university research above the historical levels for such support.

In summary, the SRC believes that the R&D credit must be made permanent. Moreover, a differentially larger credit incentive for corporate support of university basic research should be enacted to provide a substantial and fundamentally necessary incentive for corporations to increase their funding of university research activities. Such increased funding will permit the United States to continue to achieve breakthroughs in the foundations of basic scientific knowledge which are necessary to maintain a strong, competitive national technological posture.

Additionally, such funding will provide colleges and universities with the resources to attract and retain scientific faculty, to provide for larger numbers of better trained graduate students, and to provide for the modernization of laboratory facilities.

Mr. Pickle. Thank you very much.

[The prepared statement follows:]

STATEMENT OF LARRY A. SUMNEY, EXECUTIVE DIRECTOR, SEMICONDUCTOR RESEARCH CORP.

SUMMARY OF PRINCIPAL POINTS

I. Formation and Purposes of Semiconductor Research Corporation (SRC): The Role of the R&D Credit

1. SRC is a non-profit, tax-exempt organization whose 26 members are companies of diverse size that are semiconductor manufacturers, users, and suppliers. The essential purpose of SRC is to promote basic research by universities in the scientific fields underlying semiconductor technology by pooling company membership fees and contracting with universities throughout the country for the creation of major research centers and specific research projects. SRC's current annual university research budget is approximately $12 million, and SRC has been able to fund 50 of the over 150 proposals received from 52 universities.

2. The idea for creation of SRC was developed in 1981, in the wake of enactment of the R&D tax credit, and the credit was an important factor in the decision to proceed with the formation of SRC.

II. Critical Deficiencies Continue to Exist in Basic Research and University Scientific Education: The Need for an Enhanced Tax Credit Incentive for Corporate Funding of University Basic Research

1. Continued growth in semiconductor technology, and in the closely-related fields of computer and telecommunications technology, will be possible only if corresponding advances are made in the scientific fields which underly such technology. However, the costs of performing the basic research necessary for continuing technological progress have increassed rapidly. Accordingly, an industry-wide approach through cooperative vehicles such as SRC is necessary to provide adequate funding for university basic research.

2. Such industry-university cooperation also provies substantial resources to universities to improve their scientific education programs which have suffered from a chronic shortage of faculty and a lack of up-to-date scientific equipment.

3. While the response of SRC member companies under the existing tax credit incentive has been substantial, we strongly believe that great potential exists for a broad expansion of SRC's funding of university research if the tax incentives for corporate support of such research were enhanced. Since the present R&D credit, by treating corporate payments to universities for basic research in the same manner as a contract payment for product development, provides no particular incentive for a corporation to shift research projects from in-house applied research operations to university basic research, a clear need exists for the differentially larger tax incentive for university research, such as a flat rate university research credit originally supported by the full Ways and Means Committee in 1981 or the mechanism in the 1984 Senate-passed R&D legislation providing for a non-incremental credit for corporate basic research payments to universities that are in excess of a fixed "maintenance-of-effort" level.

WRITTEN STATEMENT OF LARRY A SUMNEY

My name is Larry Sumney. I am Executive Director of the Semiconductor Research Corporation (SRC).

I welcome this opportunity to appear before the Subcommittee today to voice SRC's strong support of the tax credit for research and development (R&D) activities and to urge this Subcommittee's serious consideration of proposals to broaden and improve the present tax credit as it applies to corporate payments to our nation's colleges and universities for basic research.

I. FORMATION AND PURPOSES OF SRC: ROLE OF THE R&D CREDIT

SRC is a non-profit, tax-exempt organization whose 26 members are companies of diverse size which manufacture finished semiconductor devices for sale, manufacture and purchase finished semiconductor devices for use in manufacturing other products, or manufacture equipment or materials for use by the semiconductor industry. Attached to this testimony is a list of current SRC members. The essential purpose of SRC is to promote basic research and scientific study by colleges and universities in the fields of engineering, mathematics, and the physical sciences underlying semiconductor technology. SRC operates by pooling membership and then contracting with universities in various regions of the country for the creation of major research centers as well as for specific research projects. SRC's annual budget in the current year for university research projects is in the range of $12 million. This amount substantially increases total available funding for basic research in semiconductor technology. The semiconductor industry in the past has been able to spend only 3 to 5 percent of its R&D budget on basic research -- amounting to only $35-50 million annually; additional NSF funding for such research in 1982 was $7.5 million.

In response to its initial solicitation of research proposals from universities, SRC received over 150 proposals from 52 universities, ranging from the University of Illinois to Rutgers and Princeton in New Jersey. As will be discussed in more detail later, SRC has to date been able to fund 50 proposals, awarding contracts to a diverse group of universities such as the University of South Carolina, a consortium of North Carolina universities, Columbia University, the University of Florida, Texas A&M University, Mississippi State, and the University of California at Santa Barbara. A list of these contracts -- awarded to colleges and universities throughout the United States -- is attached for your reference.

The idea for the creation of SRC was developed in 1981, in the wake of enactment of the R&D tax credit. The R&D credit was an important factor in the decision to proceed with the formation of SRC -- both because of the positive environment for R&D and university basic research which existed with the enactment of the credit and because of SRC's ability to use the tax credit as a positive sales tool to attract corporate members willing to fund university basic research activities. SRC was formed by industry to address a number of fundamental problems in the current state of university scientific education and of basic research in the fields underlying semiconductor technology. However, our efforts to date represent only a beginning: there is an ever-increasing need for substantially-broadened corporate support of university basic research and scientific education. The university basic research provisions of the R&D credit provide fundamentally necessary incentives for corporate taxpayers to address these critical problems.

II. CRITICAL DEFICIENCIES CONTINUE TO EXIST IN BASIC RESEARCH AND UNIVERSITY SCIENTIFIC EDUCATION: THE NEED FOR AN ENHANCED TAX INCENTIVE FOR CORPORATE FUNDING OF UNIVERSITY BASIC RESEARCH

The semiconductor industry, and the closely-related computer and telecommunications industries, recently have experienced tremendous and rapid growth in product innovation and market development. Future growth in semiconductor and computer technology will be able to continue only if corresponding advances are made in the foundations of knowledge in the fields of engineering and physical science which underly such semiconductor and computer technology. Yet, this crucial need for expanded basic research comes at a time when basic research in this nation has been suffering from a long decline. According to the National Science Foundation, U.S. industry now spends only 4.4 percent of every research dollar on basic research, down from 7.6 percent in 1960. University basic research has been a major casualty of this declining emphasis on civilian basic research because over 60 percent of all basic research is conducted at universities. Industry today is the source of a scant 4.1 percent of R&D dollars brought to universities, down by over 30 percent from 1960. (See National Science Foundation, Science Indicators.)

In the past fifteen years, the semiconductor, computer and telecommunications industries have experienced a dramatic surge in technological progress. As a result of this surge, the costs to our universities of educating future scientists and engineers and of performing the basic research necessary for continuing technological progress have increased rapidly. Both the increasing complexity of the technology and the need for sophisticated capital equipment which is subject to early obsolescence have increased costs substantially. Frequently, the financial resources necessary to conduct such long-term research are beyond the capacity of individual companies or universities as are the human skills to perform the research.

Accordingly, an industry-wide approach through cooperative vehicles such as SRC will be necessary to provide adequate funding for basic research in scientific fields underlying technology and product development.

Such an industry-wide approach is not only necessary but offers major advantages as well. It provides an industry-wide perspective regarding the past and future pattern of development of semiconductor, computer, and telecommunications technology and the various research problems and opportunities which lie in the forefront of such developing technology. It also promotes cooperation by industry with universities in the definition, conduct, and support of university basic research projects, thereby providing university researchers with a clearer sense of the direction in which the technology should be moving and the kinds of research problems and activities that are particularly important to industry. We at SRC strongly feel that both the industry and the universities realize very substantial benefits from this expanded scale of university basic research activities and of industry-university cooperation. This cooperation in no way detracts from the time-proven principles of academic freedom.

Not only is there industry and university benefit from the expansion of knowledge through expanded university basic research efforts, but, just as importantly, the universities receive substantial resources to improve their scientific education and training programs. At our colleges and universities, education in mathematics, engineering, and the physical, biological and computer sciences has suffered from a chronic shortage of faculty and a lack of up-to-date scientific equipment upon which the students and faculty can learn and perform research. Universities not only face great difficulty in stretching tight budgets to compete with private firms for graduate-level engineers for faculty employment, but they also face difficulty in attracting high caliber faculty because of teaching overload and the antiquated laboratory facilities available for teaching and research. The result of these chronic shortages of university science faculties and antiquated facilities is an inadequate supply of scientifically-skilled manpower, especially in critical areas such as computer science, electrical engineering, and mechanical engineering. Japan, with a fraction of the U.S. population, is currently producing more electrical engineers from its colleges and universities than is the United States.

A fundamental characteristic of high technology electronics companies is that their competitiveness, in both national and international markets, is a function of the competence and creativity of their employees. The heart of the electronics industry is research and development, which is almost exclusively a human activity requiring skilled and imaginative scientists, engineers, and technicians. For many companies -- particularly in the semiconductor industry --

manufacturing is also an activity that requires highly-trained and skilled employees. Thus, it is not surprising that high technology electronics companies view skilled and highly-motivated employees as their single most important asset. For this reason, industry is very concerned about the current critical shortage of engineers and scientists graduating from our nation's institutions of higher education.

Increased corporate funding of university basic research will provide the universities with resources to attract scientific faculty and to modernize laboratory facilities. These modernized facilities, in turn, can further help attract high caliber faculty by providing more up-to-date laboratories within which the faculty member can perform his or her research. In addition, the university basic research projects conducted on behalf of industry will themselves constitute a significant attraction to new faculty by providing the opportunity to work on a well-funded project examining research problems and issues which are on the very forefront of the scientific fields underlying industrial technology. To the extent these faculty shortages are remedied and the scientific facilities are modernized, the supply of scientists, engineers, and scientifically-skilled manpower will be increased, and a pool of highly-trained talent will be available not only to the high technology electronics industry but to a broad range of industries across this nation as well.

III. SCR'S EXPERIENCE WITH THE EXISTING R&D CREDIT DEMONSTRATES THAT INDUSTRY WILL RESPOND TO TAX INCENTIVES FOR CORPORATE SUPPORT OF UNIVERSITY BASIC RESEARCH

SRC's experience, we believe, helps demonstrate that industry has responded to the incentives contained in the present R&D tax credit for corporate support of university basic research. In the two years since SRC was formed, its membership has grown from ten to twenty-six companies, and its budget for its activities has increased from approximately $6 million in 1982 to over $15 million for 1984.

As I mentioned, in SRC's first full year of operation in 1982, it received over 150 proposals from 52 universities from around the nation in response to its initial request for university basic research proposals. SRC has awarded 50 contracts for major research "centers-of-excellence," major research programs, and individual university research projects. Awarded centers-of-excellence and major programs include Cornell, University of California at Berkeley and Carnegie-Mellon, a consortium of North Carolina universities (principally, Duke University of North Carolina, and North Carolina State), M.I.T., Clemson, Stanford, Rensselaer, and University of California at Santa Barbara. SRC plans to fund a total of at least eight to ten more of these broadscale, major research centers at universities over the next several years. University basic research activities to be conducted at these centers on behalf of SRC will include research into design of micro-structures, properties of silicon material, computer-aided design and automation of design, lithography, beam processing, fault tolerance, micro-packaging and cooling, three-dimensional silicon structures, and manufacturing systems research.

As an example of the research undertaken at these centers, Berkeley and Carnegie-Mellon are to receive a total of $1.75 million in SRC funding for joint research into computer-aided design of integrated circuits. Both of these institutions have previously pioneered in the design of complex systems in which the complexity of the largest computer system is condensed onto a 0.1 square inch chip. The growth in complexity of these computer systems is challenging the current capability of industry to reduce integrated circuits onto silicon chips. Unless very significant advances are made in the design process, the continued ability to reduce these complex integrated circuits onto silicon chips will be severely hampered. U.C.-Berkeley and Carnegie-Mellon will coordinate their programs in a broad research effort to develop the required new generations of design tools.

SRC has adopted an explicit policy of distributing a substantial number of its contracts for major research centers and individual research projects on a broad geographical basis among colleges and universities whose scientific research programs — while perhaps not as well known or prestigious as a

Harvard, M.I.T., or Berkeley -- are nonetheless of outstanding caliber. As the attached list of all institutions which have to date received SRC contract awards indicates, we have found that there is extremely capable scientific research work being undertaken at these regional colleges and universities. Moreover, it is SRC's view that complex basic research problems may be more readily solved when there are a number of educational institutions participating, bring the diverse views of a number of researchers to bear on the problem.

Perhaps more importantly, the establishment of high technology research centers and the awarding of individual research contracts at universities located in a variety of regions of this nation helps provide a basis for the geographical dispersion of high technology companies and industries. As these university research efforts expand and become established, high caliber faculty and students are attracted which in turn provides a foundation for high technology industrial development in the region. The pattern of high technology industry growing around research institutions -- such as Silicon Valley around Stanford and Berkeley and Route 128 in Massachusetts around Harvard and M.I.T. -- can be applied to many other areas of the country. With increased university research efforts, a local source will exist for scientifically-skilled manpower. Moreover, the research capability of the university will offer valuable opportunities for university-industry cooperation on research projects and will serve to spotlight the region to attract still more high technology enterprises and talented manpower from other areas of the nation. Thus, the continued development across the nation of university basic research in the scientific fields underlying semiconductor, computer, and telecommunications technology holds out important promise for the development of an industrial base of high technology in a variety of geographical regions, providing well-paying new jobs for skilled employees at all levels.

SRC's efforts, with the benefits set forth above, have been accomplished in significant part because of the existence of the R&D tax credit. If the credit is not extended, the incentive for companies to become members and expand their contributions to SRC will diminish. Accordingly, SRC strongly urges that legislation be promptly enacted to make the R&D credit a permanent part of the Internal Revenue Code. Just as individual companies undertaking in-house R&D projects today in response to the R&D credit need assurances that the credit will still be in existence at the end of the three to five-year project, so, too, SRC and the universities conducting research on its behalf need the certainty that the tax incentives which helped to give rise to necessary corporate funding will continue to exist for both new projects and projects currently being undertaken.

IV. ENACTMENT OF A NON-INCREMENTAL TAX CREDIT MECHANISM FOR UNIVERSITY BASIC RESEARCH WOULD STRONGLY ENCOURAGE BROADER CORPORATE FUNDING OF UNIVERSITY RESEARCH

While the response of SRC member companies under the existing tax credit incentive has been substantial, we strongly believe that there is great potential for a broad expansion of SRC's funding of university research if the tax incentives for corporate support of such research were enhanced. The present tax credit under I.R.C. § 44F, by treating corporate payments to universities for basic research in the same manner as a contract payment for product development, provides no particular incentive for a corporation to shift research projects from in-house operations oriented toward applied research and product development to university basic research. Because the current R&D credit is calculated on an incremental basis using a rolling base period which includes university basic research payments as well as the company's in-house product development R&D expenditures, dollars paid by the company to a university for basic research increase a company's threshold for obtaining the credit over the next three years by increasing the base period amounts applicable in those years, and thereby reduces the amount of available R&D credit in those years. Since university basic research has less direct immediate commercial value to any company that does in-house applied research and product development, there is a clear need for a differentially larger incentive if corporate taxpayers are to be persuaded to apply a larger part of their R&D budgets to fund university basic research.

The R&D credit as originally adopted by the Ways and Means Committee in 1981 included a differentially larger incentive for university research by providing a flat rate, non-incremental tax credit of 25 percent for corporate funding of university basic research. Unfortunately, this flat rate credit was not included in the so-called Hance-Conable substitute that was ultimately adopted by the full House. Hence, the university research credit supported by the Ways and Means Committee did not become law. SRC would strongly support such a flat rate credit approach to corporate funding of university basic research.

We at SRC believe that the Senate-passed R&D legislation included in its version of the 1984 Deficit Reduction Act also adopts an appropriate approach to such a differentially larger tax incentive for corporate support of university basic research. The bill creates a flat, non-incremental credit for a corporation's payments to universities for basic research that are in excess of a fixed "maintenance-of-effort" level, which is based upon 1981 through 1983 levels of the company's university research spending and of its R&D spending in general. This maintenance-of-effort minimum ensures that the new, non-incremental university research credit will be available only to corporations that increase their funding of university research above their historical levels of such support. The percentage-of-research budget floor also prevents a windfall to companies that thus far have been inactive in supporting university basic research.

One important advantage of making the university research credit non-incremental, either on a general basis or when a company's university payments exceed a fixed historical level, is that the credit continues to provide an incentive for the company to make such payments in bad years as well as good years. In a volatile industry like the high technology electronics industry, many companies must endure severe swings in earnings. In times of adverse circumstances there is a temptation for a company to cut support of university research; cutting university research funding is often simpler and less painful than laying off employees or closing company R&D or manufacturing facilities. In these circumstances a very substantial effort may be required just for the company to maintain its university research support at previous years' levels or to achieve a modest increase in such funding. A flat rate credit clearly would encourage the company to make such a substantial effort. Alternatively, under the mechanism adopted in the 1984 Senate-passed R&D legislation, so long as the company's university research payments exceed the fixed historical base, the non-incremental nature of the credit would continue to provide a significant incentive for the company to make payments for university research even in bad times.

In assessing the performance of the credit for university basic research under current law and in considering possible means by which the incentive embodied in such credit could be made even stronger, we urge that this Subcommittee give careful consideration to both the flat rate credit concept proposed by the full Ways and Means Committee in 1981 and the differential credit mechanism included in the 1984 Senate-passed R&D legislation.

V. CONCLUSION

In sum, SRC believes that the R&D credit must be made permanent. Moreover, either a flat rate credit, or the differentially larger tax credit (as set forth in the 1984 Senate-passed R&D legislation) for corporate support of university basic research should be enacted to provide a substantial and fundamentally necessary incentive for corporations to increase their funding of university research activities. Such increased funding will permit the United States to continue to achieve breakthroughs in the foundations of basic scientific knowledge and will provide colleges and universities with the resources to attract scientific faculty and to modernize laboratory facilities.

SEMICONDUCTOR RESEARCH CORPORATION

MEMBER COMPANIES

(June, 1984)

Advanced Micro Devices, Incorporated
Burroughs Corporation
Control Data Corporation
Digital Equipment Corporation
E. I. du Pont de Nemours & Company
Eaton Corporation
E-Systems, Incorporated
General Electric Company
General Instrument Corporation
Goodyear Aerospace Corporation
Harris Corporation
Hewlett-Packard Company
Honeywell, Incorporated
IBM Corporation
Intel Corporation
LSI Logic Corporation
Monolithic Memories, Incorporated
Monsanto Company
Motorola, Incorporated
National Semiconductor Corporation
The Perkin-Elmer Corporation
RCA Corporation
Rockwell International Corporation
SEMI, Chapter*
Silicon Systems, Incorporated
Sperry Corporation
Texas Instruments, Incorporated
Union Carbide Corporation
Varian Associates, Incorporated
Westinghouse Electric Corporation
Xerox Corporation

The following companies are included in the Semiconductor Equipment and Materials Institute, Inc., Chapter: Micro Mask, Inc.; Pacific Western Systems, Inc. Probe-Rite, Inc.; Pure Aire Corporation.

5/28/84

SRC CONTRACT FUNDING STATUS

Contract No.	Title	University	1st Yr. Funds	2nd Year Funds
82-11-001	Semiconductor Research Corp. Program of Microscience and Technology	Cornell	998,000	1,177,400
82-11-002	Performance Enhancement of VLSI through the Use of Advanced Cooling Techniques	Stanford	109,997	110,000
82-11-003	Transfer of Software Engineering Methodology to VLSI Design	UNC	80,475	-0-
82-11-004	Low Resistance OHMIC Contacts for VLSI Technology	Minnesota	73,000	-0-
82-11-005	An Investigation of Multilevel Interconnection & Reactive Ion Beam Source for VLSI Applications	Mississippi State	116,239	135,000
82-11-006	Theoretical & Experimental Investigations of Thermal and Accelerated Dopant/Surface Interactions during Vapor Phase Film Growth	Illinois	99,973	101,741
82-11-007	SRC-CMU Research Center for Computer-Aided Design	Carnegie-Mellon	750,000	900,000
82-11-008	SRC-California/Berkeley Center for Computer-Aided Design	UC/Berkeley	1,000,000	1,100,000
83-01-001	Physics & Modeling of Heterostructure Semiconductor Devices	Purdue	91,688	102,870
83-01-002	VLSI Circuit Layout	Columbia	88,755	89,901 2nd Year Funding Intended

5/28/84

Contract No.	Title	University	1st Yr. Funds	2nd Year Funds
83-01-003	Development of a Design Automation System for Speed-Independent VLSI	Iowa	112,031	118,013 Proposed
83-01-004	Investigations of Mechanical-Environmental Interactions in VLSI	Georgia Tech	99,974	90,000
83-01-005	Ultra-Compaction Algorithms for Symbolic VLSI Layouts	MCNC	84,535	-0-
83-01-006	Physics & Technology of Multilevel Interconnections and Contacts for Sub-Micron VLSI	Stanford	115,836	130,000
83-01-007	Chemical Vapor Deposition of Refractory Metals and their Silicides	Arizona	80,260	99,496
83-01-008	Characterization and Optimization of Incoherent Light & CW Laser Annealing in Silicon	Notre Dame	91,078	91,000
83-01-009	Complementary MESFET Devices for VLSI Technology	Stanford	101,326	106,392
83-01-010	Thermal Nitridation of Silicon and Silicon Oxides	Penn State	103,240	100,317
83-01-011	Polysilicon in Advanced Integrated Circuit Processes	Carnegie-Mellon	95,000	100,000
83-01-012	The Bipolar Transistor Structure and the Space-Charge-Limited Loads for VLSI Applications	Arizona	104,016	-0-
83-01-013	Design Verification and Testing of VLSI Circuits	Illinois	110,553	2nd Year Funding Part of a Larger Program
83-01-014	Design of Testable VLSI Circuits	Illinois	129,844	2nd Year Funding Part of a Larger Program

Contract No.	Title	University	1st Yr. Funds	2nd Year Funds
83-01-015	Very Low Temperature Silicon Epitaxy	Minnesota	116,000	116,000
83-01-016	MOS VLSI at Low Temperatures	Vermont	78,974	86,220
83-01-017	A Computer-Aided Design Methodology for Analog LSI/VLSI	Texas A&M	100,992	44,585 5 Months
83-01-018	Process-Induced Radiation Effects in Small-Dimension MOS	Yale	97,040	102,000
83-01-020	A Three-Dimensional VLSI Device Simulator	Arizona State	101,000	100,914
83-01-021	An Investigation of Molecular Beam Epitaxy Silicides for VLSI Applications	UCLA	90,800	96,307
83-01-022	On-Line Testable VLSI Processors	Carnegie-Mellon	92,150	114,580
83-01-023	VLSI Digital Signal Processors	South Carolina	96,500	
83-01-024	Application of Acoustic Microscopy to the Examination of Integrated Circuits	Minnesota	96,412	100,000
83-01-025	Performance and Failure Analysis of Microelectronics Devices by Digital Scanning Electronic Microscopy	UNC	139,917	150,000
83-01-026	Plasma & Reactive-Ion Etching with Fluorine Base Compounds	Penn State	92,464	25,000
83-01-027	Studies of High-Conductivity Silicide Metallizations for VLSI	Wisconsin	88,000	93,500

Contract No.	Title	University	1st Yr. Funds	2nd Year Funds
83-01-028	CAD Techniques for VLSI Layout	Rochester	105,000	110,000
83-01-029	Laser Repair of Transparent VLSIC Mask Microfaults	USC	116,628	101,943
83-01-030	Studies of Reliability Physics of Silicon VLSI Transistors	Illinois	130,145	130,000
83-01-031	Studies of the Origin of Si/SiO_2 Interface Studies	Stanford	110,567	116,237 Proposed
83-01-032	Hierarchical Silicon Compilation	Brown	99,000	104,000
83-01-033	Three-Dimensional Circuits and Systems Technology	MIT	747,533	850,000
83-01-034	An Evaluative Program for Assessing the Utility of Cluster Ions in Semiconductor Processing	Johns Hopkins	98,809	108,666
83-01-035*	VLSI Arrays: Applications and Layout Techniques	Illinois	101,791	2nd Year Funding Part of a Larger Program
83-01-036	Thin Isolators and Their Interfaces in Metal/	Yale	100,399	109,258
83-01-037	The Optimization of Polysil Emitters	Florida	71,864	
83-01-038	Efficient Method for Simulating MOS Integrated Circuits and Its Implementation in Currently Used CAD Tools	Arizona	65,362	94,044
83-01-039	Interface Defects in Multilayer Ceramic Substrates	Cornell	96,624	106,651

* Combined Illinois Funding is $518,655.

5/28/84

Contract No.	Title	University	1st Yr. Funds	2nd Year Funds
83-01-040	Research in Integrated Circuit Manufacturing Technology	MCNC	612,548	900,000
83-01-041	Advanced Beam Systems-Vehicle for VLSI Research	RPI	958,000	800,000
83-07-042	VLSI Reliability Research Program	Clemson	215,424	400,000 Proposed
83-12-043	Microscale Studies of the Electric Properties of Oxygen-Induced Defects in Si and Their Interactions Involved in Internal Gettering	MIT	99,780	
84-01-044	UCSB GaAs Digital Research Core Program	UC/Santa Barbara	450,000	
84-01-045	Automation in Semiconductor Manufacturing	Michigan	337,155	
84-01-046	Manufacturing Science and Technology for VLSI	Stanford	900,749	
84-02-047	Center for GaAs Digital Device Research	Stanford	150,000	
84-04-048	Low Resistance Ohmic Contacts for VLSI Technology	Colorado State	84,000	
84-06-049	Research Program in VLSI Systems: Architecture and Reliability	Illinois	518,655	
84-06-050	VLSI Packaging and Interconnection Research	Arizona	299,990	

Mr. PICKLE. We will hear from Alan Kraut, deputy executive officer of the American Psychological Association.

STATEMENT OF ALAN G. KRAUT, PH.D., DEPUTY EXECUTIVE OFFICER, OFFICE OF NATIONAL POLICY STUDIES, AMERICAN PSYCHOLOGICAL ASSOCIATION; ALSO ON BEHALF OF ASSOCIATION FOR THE ADVANCEMENT OF PSYCHOLOGY, AND FEDERATION OF BEHAVIORAL, PSYCHOLOGICAL, AND COGNITIVE SCIENCES

Mr. KRAUT. My name is Alan Kraut, deputy executive director for National Policy Studies of the American Psychological Association (APA). I am pleased to be here today representing the over 75,000 members of APA, and of our sister organization, the Association for the Advancement of Psychology (AAP). I also have the privilege today of representing the members of the Federation of Behavioral, Psychological, and Cognitive Sciences, an organization of 12 scientific societies, including APA, with research interests in these areas of science. We are grateful for the opportunity to testify on the tax credit for industrial research and development.

The organizations I represent support the basic thrust of this tax credit. However, we believe the tax credit overlooks important areas of research that have the potential to significantly increase the productive capabilities of our society: Specifically, we ask that behavioral and social science research be included as "qualified research" for which corporations may take a tax credit.

Concern over productivity in the United States has grown over the past decade as the rate of economic growth has slowed considerably. American industry and Government are being confronted with important strategic decisions on how best to revitalize the economy and promote technological growth. In many organizations, and in most public discussion of these issues, the investment that businesses have in human capital is overlooked. There is inadequate recognition of the fact that behavioral and social science technologies hold enormous promise for improving employee job satisfaction and motivation, as well as employee efficiency. These improvements will in turn reduce employee absenteeism and increase overall employee productivity. The United States has been slower than many other industrialized nations to recognize the importance of this approach and put it to productive use.

A well-known example of a country that has successfully used the results of behavioral and social science research to dramatically increase economics is Japan. From the start of the rebirth of Japanese industry following World War II, the Japanese have been highly receptive to utilizing the results of behavioral and social science research on industrial organizations.

As a result, Japan has been able to achieve its enviable improvements in rates of productivity and product quality. Ironically, most of the concepts adopted by the Japanese to achieve these impressive results, including the "quality control circles" we hear so much about, were developed by behavioral and social scientists in the United States.

When the Economic Recovery Tax Act of 1981 provided tax credits to corporations for most kinds of new research, the intention was to stimulate private sector research and development, with the hope that this, in turn, would increase technological innovation and productivity. However, ERTA explicitly excluded social science research from qualifying for such tax credits, even though the behavioral and social sciences have made tremendous contributions to productivity and economic growth in this country.

Executives from numerous U.S. firms have stated publicly the value of the behavioral and social sciences to their firms in enhancing such important factors as productivity, employee satisfaction, and the match between person and job. To continue to exclude social and behavioral research from the favorable tax treatment offered to corporations through this tax credit is to create disincentives for firms to invest in this valuable research. Industry and society as a whole would lose potential benefits.

Creating and implementing new technologies depends as much on humans as on industry hardware. People are indispensable components of the economic system, and the appropriate use of human skills and effort for maximum productivity requires considerable research into such areas as: What factors determine how well a person will perform a job; how people function best in various organizational settings; and how the introduction of new technology into a work setting will affect these and other, factors.

Let me demonstrate the direct link between behavioral and social science research and productivity and innovation by citing a few contributions of American behavioral and social science research to industry.

HUMAN FACTORS ENGINEERING

Human factors engineering is concerned with the design of workplaces, working environments, and the equipment, to maximize the efficiency of the human operator in a system. A worker's ability to perform can be very much improved by the design of work settings in keeping with human abilities and limits. Examples range from the arrangement of control rooms in nuclear powerplants to the design of airplane cockpits.

In the field of aviation, a great deal of work has been invested in the design and placement of gauges and controls in the aircraft cockpit for maximum readability and efficiency of control. These are critical elements when many human lives and millions of dollars in equipment depend upon rapid and accurate human judgment and performance in an extremely complex work setting. One dramatic example involves the Boeing 727 airplane that I am sure we have all flown in.

In the 6 months following the introduction of the 727, a series of four tragic airplane crashes occurred, all involving night landings. A psychologist at Boeing researched the problem and discovered a visual illusion that was the major cause of the fatal accidents.

Mr. **Pickle**. What was the cause?

Mr. **Kraut**. A visual illusion that the pilot was unaware of caused these accidents.

The result was the elimination of a problem which had been measured not only in dollars, but in human lives. And isn't that worth a tax credit?

The nuclear power industry has paid dearly for not considering human factors engineering at early stages. The accident at Three Mile Island demonstrates that behavioral and social science elements can be as important as physical and technological factors. The Kemeny Commission, which investigated the accident, concluded that it was primarily "people-related problems and not equipment problems" that brought the Nation so close to a major tragedy. The Nuclear Regulatory Commission has since shown considerably more interest in such approaches, and has enlisted the assistance of human factors specialists to aid in the upgrading of these elements of nuclear plant design and operation.

ROBOTIC TECHNOLOGY

The study of how the increased use of robotics, or automation, will affect the individual worker in terms of productivity, morale, work conditions, and motivation is a new and important field of study. Most of the research in robotics to date has been on its technological aspects. However, the human implications of robotics must be more fully understood if industries are to benefit in the longer term.

We need to assess the impact of the technology on individuals, the economy, and on the American society as a whole. Some of the robotics-related areas being studied by psychologists include: How a change in work environment and retraining affect productivity and morale; how a worker's role in an organization changes as he or she interacts with robotic equipment; and how the design of equipment and workplaces affect the worker.

ARTIFICIAL INTELLIGENCE

In studying artificial intelligence, a field related to robotics, psychologists are examining the nature of intelligence and how it stems from lower level cognitive functions. Behavioral scientists work with computer specialists to develop increasingly complex computer systems to support powerful problem-solving and learning mechanisms. This work translates directly into more powerful applied systems.

Research in artificial intelligence can help industries to understand not only how computers carry out humanlike activities, but also the ways in which they may be able to exceed human performance. Another related line of research investigates the design of computer systems so that they can be more fully understood and more effectively used by humans.

Again, our organizations support the basic thrust of this tax credit for research and development, but we believe the exclusion of behavioral and social science research severely limits the potential of the tax credit to increase industrial innovation and productivity. We strongly urge you to expand the categories of research expenditures to include behavioral and social science.

I would be pleased to provide additional information or answer any questions you might have. Thank you.

Mr. Pickle. Thank you, Mr. Kraut. I regret that we have had to limit you to a 5-minute summary, but your entire statement will be included in the record.

I have a question I want to ask, but before I do that I want to say again that the committee appreciates that you have stayed with us, allowing us to go through the lunch period so we can conclude this. I hope this will send you away at a little earlier time. But we do appreciate your cooperation.

I came in a little bit late for this last panel, and I don't know whether testimony was asked to be submitted by our colleague, the Honorable John Myers. I see him in the audience.

Did you want to make a statement?

Mr. MYERS. Just to be present for the testimony of my friend, Dr. Beering.

Mr. PICKLE. You come well recommended when John Myers appears with you. He is one of our most experienced and distinguished gentlemen with whom we serve, and we are proud to have him here with us today.

Mr. MYERS. Thank you.

Mr. PICKLE. Dr. Beering, I want to ask you, in your statement on page 5 you point out that the present law we have has not really been in effect long enough to allow us to assemble compelling statistics to show how effective this credit has been.

In view of your statement I want to ask you this. You indicate that the incentive for the credit "scarcely exists," I believe that is your phrase. The question that comes up is would the corporations have given you money anyway or did we, the committee, just waste some of our revenue in providing these credits? Can you give me any reaction to that summation?

Mr. BEERING. I think in view of the general downturn in our economy during the same period we endeavored at all levels in business and industry, at the State level and the Federal level, to provide for a whole series of incentives that were all aiming in the same direction, which is one of the reasons we brought you that conclusion.

The other is that the evidence is unmistakable, at least in the university segment, that there has been a major increase in the participation in terms of dollars by business and industry with us in research. But the reason I said it is a little early to speculate as to the results is that obviously the incubation of the research requires 5 to 10 years before we have a product on the other end that is useful. So I don't know whether I could give you any evidence that would be in support of the assumption you posit, that if this particular tax credit hadn't been part of the incentive mix, the same findings might be before us today. I don't have an answer for it.

Mr. PICKLE. Did your university—Purdue University—enter into more contracts or fewer contracts by virtue of this program?

Mr. BEERING. We have more programs by far, and it is going up at the rate of four times any other research expenditure annually.

Mr. PICKLE. I am a little bit concerned. You say it scarcely existed. We buried them before the life got started. "We hardly knew you."

Mr. BEERING. That is right.

Mr. PICKLE. Now, you say that you have had a great deal of increase.

Mr. BEERING. Before 1981. As I said in the testimony, it is temporally related, but I am not sure that it is causally related.

Mr. PICKLE. It picks up in 1982, 1983, and now 1984?

Mr. BEERING. Yes, and it continues to rise.

Mr. PICKLE. Even with the sunset, it is rising now?

Mr. BEERING. It is still rising.

Mr. PICKLE. You might submit for us some figures to show this as a typical experience for a university.

Mr. BEERING. Yes. Our association could probably provide you with those figures on a broader scale than just one university. I would be happy to do it.

Mr. PICKLE. You might submit for the record the information on basic research contracts your university might have received.

I would like to get the same from you, Mr. Sumney. I would like to know what specific contracts you were able to enter into.

[No additional information had been received at the time of printing.]

Mr. BEERING. I can give you two examples that probably would not have existed before. One is a major $5 million program which we are doing to develop using the super computer robotics for industry, and that entails five industrial partners with us. Another is, in part, a State incentive to develop extraction of nitrogen from the air, salt from water, and that is participation by both industry and the State. We have been told that the incentive, in part, was the tax credit.

Mr. PICKLE. Upon reading your testimony I was uncertain as to what you really thought this meant to universities. I assume you have reference primarily to 1981 and early 1982, but it is showing a definite relationship at this point?

Mr. BEERING. Yes, indeed.

Mr. PICKLE. That is what I was trying to establish.

Mr. SUMNEY. I have listed in the submitted testimony the specific contracts that we have with universities, but I think it is important to point out that the concept of cooperative research—where corporate dollars are being pooled to do generic research in universities—I don't think would have been possible without the R&D tax credit.

We have used the R&D credit as a substantial mechanism for encouraging companies to join, and the numbers of companies that have joined has far exceeded our original projections. We are up to 31 now, with an additional three that have applied for membership.

Mr. DUNCAN. Thank you, Mr. Chairman. I have one question.

Mr. Sumney, you indicated that the States that receive grants from your group are also represented on the Ways and Means Committee; however, I notice the absence of Tennessee and Texas. I wish you would get to them.

Mr. SUMNEY. We will do that.

Mr. DUNCAN. Thank you very much.

Mr. PICKLE. That might make more of a response.

Mr. SUMNEY. We have been working with the universities in Texas, in Austin specifically. I know two or three individuals down there that have moved from Illinois to the University of Texas at

Austin, and we have been working with them in trying to put together some programs.

Mr. DUNCAN. I have the University of Tennessee in my hometown, so you are missing something.

I would like to join Mr. Pickle in thanking you gentlemen for staying with us. You are a good panel, may be the best one. Thank you.

Mr. PICKLE. Mr. Kraut, has your association been given any R&D credits or have you just been precluded under the basic law we passed?

Mr. KRAUT. As far as we can determine, we have been precluded.

Mr. PICKLE. As far as you know, you haven't received any credits?

Mr. KRAUT. That is right.

Mr. PICKLE. Now, you want them?

Mr. KRAUT. We want a chance.

Mr. PICKLE. You want to get a share of it.

Dr. Kahne, you have indicated in your testimony that, as I recall, you are beginning to see signs that the R&D credit is becoming effective. Is it just now coming to light? Is it just now developing, or what? It didn't sound like a very powerful factor in your association.

Mr. KAHNE. As you have pointed out, the activity is rather new, and after just a couple of years it is hard to see very definitive signs. There are two places, however, where it is easy to see results. One is in the equipment donations, and equipment donation is something that one does or doesn't do on a given day. And the equipment donations to our institution have gone up dramatically in the last several years.

You are probably aware of several major grants by major corporations such as IBM numbering, in the case of IBM it was $50 million at one shot. That is something that is really unheard of in American industry, and it happened in the last couple of years.

The other thing that happened is new companies that have not previously participated in university research are beginning to show some interest, and when we talk to them in their offices they tell us it is because of the changes in the tax law.

Mr. PICKLE. This brings up a question I think might be worth exploring with you. You have indicated that we started in 1981, we didn't get the rules out until 1982, and then it was supposed to be sunsetted, and that created a lot of uncertainty. The question before us to be considered at some point is if we were to extend the credits, do we extend them for 3 years, for 5 years, or do we make it permanent? It will be part of our consideration. You have testified, both from of you, I assume, and said the credit ought to be a matter of some certainty, so you can depend on it, both from the university association's and from the corporation's standpoint.

Let me ask you, do you think these credits, if we continue them, should be permanent or should they be for, say, 7 or 8 years? One witness today said 5 years.

Mr. KAHNE. I believe that nothing is permanent. I think the intention to state that something is permanent is an intention that it will be a long-term effort. I believe that a 3-year or a 5-year experiment simply isn't long enough to learn enough. If you say permanent, in 10 years it may be changed but at least it will give an indication that everyone understands that in order to see results it is going to take more than a few years.

Mr. PICKLE. Then you are saying that it ought to be more than 3 or 5 years?

Mr. KAHNE. Yes.

Mr. PICKLE. But it ought not to be permanent because that doesn't mean much.

Dr. Beering?

Mr. BEERING. I would agree with that. I don't know what the technical aspects are of the limits of congressional authority. I presume you don't like to go beyond the 3- to 5-year term as currently constituted. I would agree totally with what Dr. Kahne says. We want to imply that we need more than the 3 to 4 years that have been thus far talked about. If you wish to make it permanent, fine. If you want to do something beyond, between permanent and 5 years, we will accept that, too, I am sure.

Mr. PICKLE. Mr. Sumney?

Mr. SUMNEY. I would agree that 3 to 5 years is probably not long enough to be able to measure the results of something like that. I said in my testimony "permanent" with the understanding that permanent would be something in the longer term, certainly exceeding 5 years.

Mr. PICKLE. Mr. Kraut?

Mr. KRAUT. Since behavioral social scientists haven't been able to take advantage of this tax credit we certainly would be willing to put social science in for an evaluation component, that is, to have a 3 to 5-year period to make social science applicable for this tax credit, and then to do some kind of evaluation.

Mr. PICKLE. You would be glad to get it for 1 year, wouldn't you? I would like to know what kind of basic research is being carried on through this R&D credit with respect to your universities and associations. I would like to know the type of research, and the amount of money that has been involved since this program has been underway. Try to update it as far as you can, that is, into 1984. We are trying to get information. We are trying to get facts now for purposes of evaluation, so we need to get that from you. I want to know the amount and the type of R&D that has been carried on by virtue of this program. That would be helpful to us. And if you have any other information to suggest, you may want to submit in a follow-up. We would like to have it.

We have issues before us that are going to bother the Congress next session. From my viewpoint we have a program that just must be continued, and I would speak with some self-interest in this instance. I come from a district that has a lot of high tech and a major research university. I am also wrestling, on the other hand, with our deficit, and when we have such a huge deficit there is going to be a lot of competition for the dollar.

You talk about needing R&D credits to get into international competition. That won't be anything compared to competition of the various programs in 1985 and 1986 in trying to get into the budget. So what we recommend in this field must be substantiated by hard cold facts to show that we are doing the right thing and that it makes sense. The information that you can give us will be very helpful.

We appreciate your coming, and again I want to thank you for staying with us this long. It is not always best to hold a hearing on a Friday and into Friday afternoon, but you certainly have given us excellent cooperation, and I thank you.

I don't see any other members who may have other questions. Unless any of you have any additional statements, again I thank you very much.

This session of the hearing will be adjourned. The committee will be adjourned.

[Whereupon, at 1:30 p.m., the hearing was adjourned.]

[Submissions for the record follow:]

STATEMENT OF THE AEROSPACE INDUSTRIES ASSOCIATION OF AMERICA, INC.

The Aerospace Industries Association of America, Inc. (AIA), representing the nation's major manufacturers of aerospace products, aircraft, aircraft engines, spacecraft, satellites and missiles, as well as the power plants and components thereof, appreciates the opportunity to comment for the record on the 25 percent incremental research and development tax credit, which was enacted as a provision of the 1981 Economic Recovery Tax Act.

The 1981 Act provided a much-needed and long overdue incentive to U. S. industry to increase its expenditures for research and development (R&D). In the last several years, numerous studies and reports have reiterated that the survival of the U. S. as an industrial leader in the world will depend in large part on the country's ability to mount a national research and development program that can regenerate U. S. innovative capability.

For many years, the United States was acknowledged as the world technology leader, a factor that was a critical underpinning for a strong national economy and U. S. pre-eminence in the world marketplace. But as witnesses from the high technology sector of American industry pointed out to the Subcommittee during its August hearings, the leadership stature of the U.S. in terms of technological superiority and export competitiveness is being successfully challenged. Having recognized the linkage between American technological capabilities and increased U. S. employment, real output, productivity and a strong trade posture, foreign manufacturers and their governments have increasingly targeted their own high technology industries for political and financial support. Such support -- running the gamut from R&D incentives and subsidies to export financing and marketing support -- contributed to a decade of decline in the U. S. international trade balance, a trend that produced 1983's all-time record trade deficit of $60.7 billion.

The best opportunity for reversing this continuing negative trade trend -- and strengthening national defense -- lies in bold and innovative technology thrusts geared towards creating products that combine compelling technological superiority and exceptional cost effectiveness. Such a technological surge is particularly feasible in aerospace, where the U. S. still maintains an overall technological edge and a large, though declining, market share. Aerospace merits special attention in view of its importance to the nation in the areas of national security, transportation, communications, science and technology, and the overall national economy. Employing well over one million people, the industry's 1983 sales totaled $76.5 billion, including exports valued at $16.1 billion; the positive aerospace balance of trade of $12.5 billion cannot be overemphasized in light of the record overall U. S. trade deficit.

Accompanying this statement for the record is a copy of a study AIA published earlier this year, entitled "Aerospace Technology for the 1990s", which analyzes a broad array of technologies and identifies those that have the potential for very large improvements in the cost and performance of aerospace products that will be in service in the next decade. Developing the essential technology to achieve the gains envisioned in this study will, however, be costly. A national industrial R&D strategy must recognize that if the U. S. is to revitalize its technological capabilities, and hence its international competitiveness, substantially increased investment in R&D by both government and industry is necessary. Additionally, the strategy should advocate incentives that encourage industry to make the requisite large, long-term investments.

↓ Study maintained in committee files.

To this end, the 25 percent tax credit was a step in the right direction. However, the incremental feature of the credit is not equitable for an industry such as aerospace that is already investing so heavily in R&D. The current structure of the credit provides an incentive only for increased research programs, even where the existing level of investment is extremely high. Economics is a critical factor in undertaking every research program, whether the program represents a higher level of effort or continuation of an existing effort. Denying the tax credit for continuing research activity may eliminate the financial resources needed to undertake many meritorious projects.

Most research programs in the aerospace industry are of a long-term nature, spanning three or more years. Once a new long-term program is undertaken, assuming other programs remain constant, the current 25 percent credit will apply only to the beginning costs -- but the full costs of new, short-term programs will qualify. Thus, the incremental feature of the credit works to the detriment of the typical aerospace company whose expenditures, while high, may fall below an earlier level due to cyclical peaks and valleys in R&D outlays.

The present credit's structure can also have a distorting effect by providing an incentive for more work to be performed at the beginning stages of a new program, where normally such work would be performed at a later stage. There may also be an incentive to defer a project until the following year. This restriction of the credit unfairly penalizes those companies which have maintained research activities over the years, as opposed to those companies which have not. AIA therefore believes that the current provisions of the statute should be modified to provide a meaningful level of credit, which could be somewhat less than the full 25 percent, for continued, sustained research activity. Furthermore, as many witnesses emphasized in their testimony, any tax incentive for R&D expenditures should be provided on a long-term, if not permanent, basis. Even with the option to extend a credit beyond its "sunset" date, the uncertainty entailed is disruptive from a business planning standpoint.

Language accompanying the 1981 Economic Recovery Tax Act also poses a problem for aerospace companies seeking to take advantage of the intended R&D incentives. The problem arises in connection with conflicting interpretations of the accounting treatment of independent research and development (IR&D) conducted by government contractors. IR&D is treated by industry as an overhead expense -- in either commercial or government business. The difference between commercial and government business is that the Department of Defense negotiates with many contractors, especially large contractors, an advance agreement which limits or places a ceiling on the amount which the contractor may charge to government contracts.

This advance agreement is not a promise of reimbursement of independent research and development overhead costs. Instead, it limits the amount of IR&D costs chargeable to government contracts. It should be noted that IR&D costs are clearly distinguishable from those R&D costs which are required by contract. In fact, this is recognized in the Federal Acquisition Regulation (31.205-18) which reads in part as follows:

> Independent research and development (IR&D) means a contractor's IR&D costs not sponsored by or required in performance of a contract, grant...

This is also in line with the recommendation of the Grace Commission:

> Independent Research and Development costs should be recoverable by defense contractors in the same manner as other bona fide overhead expenses.

The report accompanying the 1981 Economic Recovery Tax Act is not clear as to whether all IR&D conducted by government contractors qualifies for the credit. In the course of developing implementing regulations, this has raised questions within the Treasury Department as to the eligibility of all IR&D for the credit. Therefore, in order for the Act's incentives to be fully effective, AIA urges clarification of the present language to ensure the eligibility of all IR&D for the credit.

The 1981 Economic Recovery Tax Act also limits the tax credit to 65 percent of the R&D efforts funded by a company and performed by a university. Again, in order to reach the goals intended by the incentive, this should be raised to 100 percent.

Finally, the amortization period of purchased R&D should be accelerated to occur over a period of, for example, 60 months.

It seems quite illogical that in the effort to accelerate the national R&D program by providing tax incentives to industry, that part of our high technology industry which is likely to provide the most innovative and advanced developments of all should be precluded from fully employing such incentives.

The aerospace industry realizes that in the short run, effective incentives will involve an obvious reduction in revenue to the U. S. Treasury. In the long run, however, an investment in such incentives will pay dividends in the form of increased tax revenues as new and improved products enhance the competitive position of the United States in the world market.

Aluminum Company of America,
Pittsburgh, PA, September 20, 1984.

Mr. John Salmon, Esquire,
Chief Counsel, Committee on Ways and Means,
Longworth House Office Building, Washington, DC.

Dear Mr. Salmon: I appreciate the opportunity to comment for the 1984 August 02 hearing record of the Subcommittee on Oversight concerning the issue of research and development tax incentives.

Research and development is critical to this country's economic competitiveness. Alcoa supports the need for tax incentives to stimulate research and development in the United States. We believe that the incremental R&D credit should be made permanent or at the least extended for an additional period of time.

Certain aspects of the credit deserve further study. For example, consideration should be given to eliminating the incremental "base period" concept. The base period limitation only encourages incremental increases in R&D. Due to this base period limitation, companies may be encouraged to defer additional R&D expenditures until they exceed their base and are entitled to the credit. Tax incentives should be provided to encourage all levels of new and innovative research and development on a current basis.

Also, Congress should clarify the definition of "qualified research" under § 44F(d). Although the statute provides that qualified research has the same meaning as the term "research or experimental expenditures" under § 174, the Conference Committee Report adopted the House Report which includes several variations from the historically developed definition of research or experimental expenditures under § 174. The Congress should be encouraged to clarify the meaning of the term without substantial modification. The definition under § 174 is longstanding, and well understood. Moreover, the definition has developed sufficient legal precedent to increase certainty and yet be workable and flexible. The existing definition does not effectuate Congress' intent to promote U.S.-based research.

Other taxpayers have commented on the problems that the Proposed Regulations have caused and how the proposed regulations deviate from existing law. Primary examples are the discussion of prototypes and the discussion of computer software. If new definitions or stricter definitions are imposed, these new definitions could pose significant administrative burdens. For example, new instructions would be required to gather the necessary data. In addition, if base periods would have to be recalculated, a serious administrative hardship would be imposed. In order for the credit to be effective, taxpayers must be provided certainty of consistent definitions for qualified expenditures.

In addition, we strongly support the continued moratorium on the allocaton of R&D expenses under Treas. Reg. § 1.861-8 as an additional incentive for the performance of R&D in the United States. Because U.S. businesses are required to allocate a portion of the U.S. parent's R&D expenditures to their foreign affiliates when computing their foreign tax credit, such an allocation can negatively impact research and development in the U.S. We are aware of no foreign countries which permit foreign affiliates to deduct these expenses which are arbitrarily attributed to them. This results in the effective disallowance of these deductions and an increased tax burden on U.S. business.

Sincerely,

Albert E. Germain,
Vice President—Taxes.

American Chemical Society,
Washington, DC, September 17, 1984.

Hon. Charles Rangel,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives, Washington, DC.

Dear Congressman Rangel: The American Chemical Society, a nonprofit scientific and educational organization with a membership of 131,000 chemists and chemical engineers, favors the continued availability of the research and experimentation tax credit (Internal Revenue Code Section 44F), with certain modifications described below. Our comments focus on the revisions to Section 44F approved by the Senate on May 17, 1984, during its consideration of the Omnibus Deficit Reduction Act of 1984 (now P.L. 98-369). The Society found most of the Senate-approved revisions to be reasonable and appropriate, and we expect these revisions to be an important factor in the debate on this issue in the next Congress.

Definition of Qualified Research. The Society supports the revised definition of qualified research approved by the Senate. Narrowing the definition will help insure that the credit is available only to organizations engaged in research and experimentation designed to produce technologically new or improved business components. In other words, the credit should not be available for activities where the modifications are only stylistic or cosmetic.

Computation of Allowable Credit. The Senate-approved revisions to Section 44F also included a modification of the way the credit for payments to support university basic research was to be computed. Under present law, research expenditures qualifying under the credit include 65 percent of a corporation's expenditures (including grants or contributions) pursuant to a written research agreement for basic research to be performed by universities or certain scientific research organizations. According to the Senate Finance Committee explanation of this provision (SRpt. 98-169, vol. 1, p. 914):

"A 25-percent tax credit applies to the excess of 1) 65 percent of corporate cash expenditures for university basic research over 2) the sum of the greater of two fixed research floors (the average yearly amount of the corporation's credit-eligible university basic research expenditures for 1981-1983 taxable years, or one percent of the average yearly amount of all the corporation's credit-eligible research expenditures for those years) plus an amount reflecting any decrease in nonresearch giving to universities by the corporation during a moving base period".

The Society favors this broadening of the credit because it tends to increase corporate support for university research.

Prepayment Rule for Contract Research. The Society also favors modification of the so-called "prepayment rule" for contract research. Current law requires that amounts prepaid by a corporation for contract research must be treated as paid during the period in which the research is conducted. By applying the current rule to these corporate payments, a nonprofit research fund may be prevented from accumulating the necessary assets to build up an endowment, the income from which would be disbursed as research grants to universities and colleges.

The Senate approved revisions, were they to become law, would exempt from the prepayment rule payments that are made, either directly or through a research fund, to support basic research in universities and colleges. This modification would allow a corporation to contribute to a research fund and take the credit in the year the contribution is made, rather than the year the funds are actually spent. This would provide a greater incentive for private sector contributions to such funds.

Life of Credit. Finally, the Society agrees in principle with the Senate-approved revision to extend the life of the credit, but agrees with the Department of Treasury that it be for a period of three years.

A major reason the credit should be extended is due to its impact on small companies. A small, innovative chemical company, for example, would be able to hire an additional researcher, or pursue a promising line of inquiry, with the additional revenues available through the credit.

On the other hand, the Society believes that more data are needed on how effective the credit has been in increasing the amount of research performed. While the amount of private sector money spent on basic research has increased since the credit was enacted in 1981, it is uncertain how much of this increase is due directly to the existence of the credit. Of course, we do not rule out making the credit permanent at a later date, if additional data indicate that a permanent research tax credit is justified.

If the American Chemical Society can provide any assistance in this matter, please do not hesitate to call on us. Thank you for this opportunity to present our views.

Sincerely,

WARREN D. NIEDERHAUSER,
President.

ASSOCIATION OF INDEPENDENT RESEARCH INSTITUTES,
Shrewsbury, MA, August 15, 1984.

Hon. CHARLES B. RANGEL,
Rayburn House Office Building, Washington, DC.

DEAR MR. RANGEL: As a follow-up to the Oversight Subcommittee Hearing on the research and development tax credit, I would like to advise you of the strong interest of non-profit Scientific Research Organizations in the continuation of this provision in the tax code.

I am enclosing for your information a brochure which describes the work we do and which lists the membership of the Association of Independent Research Institutes.

If I can provide you with any additional information or answer any questions you may have please do not hesitate to contact me.

Sincerely,

FEDERICO WELSCH, M.D., Ph.D.,
President.

ASSOCIATION OF INDEPENDENT

RESEARCH INSTITUTES

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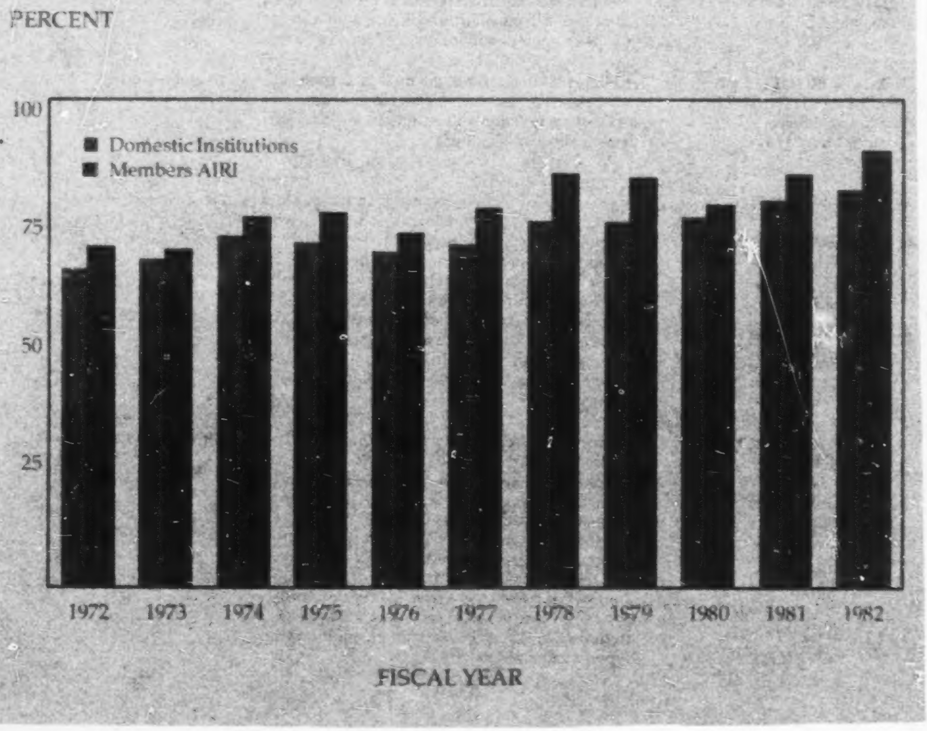
(617) 842-8921

Independent research institutes perform 12% of all research and development in the United States. Their primary mission is research. Important secondary functions are education and service. The nation's larger non-profit independent biomedical research institutes formed AIRI in 1962 in order to share information and experience and cooperate in common objectives. AIRI now has a membership of 48 institutions.

Very high approval rates of competing research project grant applications by the peer review system — illustrated below for the NIH — indicates the high quality of research at AIRI institutions.



APPROVAL RATES FOR INSTITUTIONS SUBMITTING COMPETING RESEARCH PROJECT GRANT APPLICATIONS (BASED ON APPLICATIONS SUBMITTED)

INSTITUTION	ACCOMPLISHMENTS	SCIENTIFIC/ ADMINISTRATIVE HEADS
AMERICAN TYPE CULTURE COLLECTION 12301 Parklawn Drive Rockville, MD 20852 (301) 881-2600	Acquires, preserves, characterizes and distributes 34,000 strains of 9,500 species of algae, bacteria, cell lines, fungi, protozoa, rickettsiae and viruses worldwide to scientists and industry. Conducts basic and applied research in molecular and cell biology, cryobiology and immunology. Manages an international data base on hybridoma cell lines and maintains a microbiological identification data base for the FDA. Fifteen major scientific societies have designated the ATCC as an official repository for genetic material used by their scientists. ATCC is also an international patent depository.	Dr. Robert E. Stevenson Mr. Robert J. Walden
AMERICAN HEALTH FOUNDATION 320 East 43rd Street New York, NY 10017 (212) 953-1900	Is devoted to disease prevention through epidemiological investigation of cancer and cardiovascular risk factors, laboratory identification of their biomedical mechanisms of action, and practical and cost-effective intervention to reduce risk factors in school, worksite, and other populations. Pioneered in research on carcinogenic effects of smoking and high-fat diets; also active in investigating environmental mutagens and carcinogens.	Dr. Ernest L. Wynder Mr. Richard B. Klarberg
BIGELOW LABORATORY FOR OCEAN SCIENCES McKown Point W. Boothbay Harbor Maine 04575 (207) 633-2173	Investigates the biological productivity of the oceans and attempts to understand marine environments. Focuses on the biology of blue-green algae and of red tide toxins. Houses and maintains the National Culture Collection of Marine Phytoplankton.	Dr. Charles S. Yentsch Mr. Robert M. Kidd
BIOMEDICAL RESEARCH INSTITUTE 12111 Parklawn Dr. Rockville, MD 20852 (301) 881-3300	Early research led to cryopreservation of spermatozoa and to the successful production of calves from fertilized egg transplants. Presently BRI is a major facility for malaria and schistosomiasis vaccine development and for cryobiological research.	Dr. James Leef Ms. Kathleen Giovannelli
BOSTON BIOMEDICAL RESEARCH INSTITUTE 20 Staniford Street Boston, MA 02114 (617) 742-6580	Attempts to understand: the molecular basis of heart, vascular and skeletal muscle function; metabolic regulation and its alterations in cancer; and the process of aging.	Dr. John Gergely Mr. Vincent Raso
CALIFORNIA PUBLIC HEALTH FOUNDATION P.O. Box 520 2151 Berkeley Way Berkeley, CA 94704 (415) 540-2558	Engaged in studies of monoclonal antibodies to specific antigens of several viruses; antigenic and functional domains of herpes simplex virus glycoproteins; protective T-cell subpopulation responses in leukemia; data collection for the Center for Disease Control; studies on the relationship between cancer and steroid hormones; clostridial toxins as causes of sudden infant death; the incidence of toxic shock syndrome; and the epidemiology and natural history of genital herpes.	Dr. Edwin H. Lennette Mr. Henry J. Ongerth
CANCER RESEARCH CENTER 115 Business Loop 70 West Columbia, MO 65201 (314) 875-2255	The main research focus of the CRC involves production, isolation, and purification of the biological response modifiers lymphotoxin and MAF. Strong emphasis is also placed on an instrumentation development program of a multiformat, computer-driven cell deposition system designed to work in conjunction with the fluorescent activated cell sorter. The Women's Cancer Control Program screens over 7,000 asymptomatic Missouri women over 35 for breast, colorectal, uterine-cervix, and skin cancers, in addition to hypertension.	Dr. Ben W. Papermaster

COLD SPRING HARBOR LABORATORY Cold Spring Harbor New York 11724 (516) 367-8397	Basic research in neurobiology, plant genetics and cancer, using such techniques as recombinant-DNA and monoclonal antibodies. Site of the prestigious Symposia on Quantitative Biology and of Workshops on Molecular Genetics and Molecular Neurobiology. Dr. James Watson, Director of the Laboratory, received the Nobel Prize as co-discoverer of the double helix, and Dr. Barbara McClintock for her work on jumping genes.	Dr. James D. Watson Mr. William Udry
EYE RESEARCH INSTITUTE OF RETINA FDN. 20 Staniford Street Boston, MA 02114 (617) 742-3140	Has significantly added to basic knowledge about normal and diseased eyes and developed many instruments to improve the diagnosis and treatment of eye diseases. Responsible for doubling the success rate of corneal transplants and tripling the success rate of treating retinal detachment. Results of ERI research improve the vision for more than 200,000 patients every year.	Dr. Charles L. Schepens Dr. Richard L. Pharo
FORSYTH DENTAL CENTER 140 Fenway Boston, MA 02115 (617) 262-5200	Largest private dental research center in the world. Conducts multidisciplinary research on oral diseases, including caries and periodontal problems which cost the U.S. 16 billion dollars a year. Its fluoride research program has substantially contributed to the national decline in dental decay.	Dr. John W. Hein Mr. Arthur D. Marcotti
FOUNDATION FOR CARDIOVASCULAR RESEARCH 85 N. El Molino Pasadena, CA 91101 (213) 792-4173	Experimental work in the area of cardiac excitability. New pharmacological agents such as Grisorixin are under study. This ionophore for example, shows promise as a scintographic adjuvant in the evaluation of coronary artery disease.	Dr. Richard S. Cosby Dr. Alvin Siger
FRIENDS MEDICAL SCIENCE RESEARCH CENTER, INC. 22 Bloomsbury Avenue Baltimore, MD 21228 (301) 747-0243	Research in the area of narcotic addiction to provide statistical documentation of the relation of incidences of crime to narcotic addiction and effectiveness of treatment programs.	Mrs. Meta P. Barton Mr. Richard H. Meacham
JAMES N. GAMBLE INSTITUTE OF MEDICAL RESEARCH 2141 Auburn Avenue Cincinnati, OH 45219 (513) 369-2582	Clinical studies show that rubella vaccination protects some individuals for only 6 to 8 years and that drinking water containing "insignificant" numbers of enteric viruses can cause infections in susceptible individuals. New tissue culture techniques aid in the diagnosis and prevention of influenza and other viral diseases.	Dr. Gilbert M. Schiff Ms. Beverly Simrall
LEO GOODWIN INSTITUTE FOR CANCER RESEARCH, INC. 1850 N. W. 69th Avenue Plantation, FL 33313 (305) 587-9020	A live attenuated herpes vaccine prevents genital infection in rodents and may be relevant to the prevention of cancer of the cervix in humans. Drugs and hypothermia are synergistic in the treatment of experimental brain tumors. The mechanism of hyperbaric oxygen induced immunosuppression is under study.	Dr. Joel Warren Mr. John Doerfer
HASKINS LABORATORIES, INC. 270 Crown Street New Haven, CT 06510 (203) 436-1774	Performs basic research in the field of human communications, specifically on speech perception, speech production and reading. Conducted the basic research that made possible synthetic speech from printed texts and therefore reading machines for the blind.	Dr. Alvin M. Liberman Dr. Michael Studdert-Kennedy

HELICON FOUNDATION 4622 Santa Fe Street San Diego, CA 92109 (619) 272-3884	Basic biological research in biochemistry, molecular biology and genetics. Programs are underway on chromosomal telomeres, rhizobacterial siderophores and photosynthetic bacteria. New interests center on the prevention of disease by nutritional means.	Dr. Charles A. Thomas, Jr. Mr. William C. Stern
HOWARD HUGHES MEDICAL INSTITUTE P.O. Box 330837 Coconut Grove Florida 33133 (305) 448-5522	Supports some 70 geneticists, immunologists and endocrinologists at 11 academic institutions (Baylor, Duke, Harvard, Johns Hopkins, Stanford, Vanderbilt, Washington Univ., Yale, and the Universities of Utah, California-San Francisco, and Washington-Seattle).	Dr. George F. Cahill, Jr. Mr. Kenneth E. Wright
HUNTINGTON MEDICAL RESEARCH INSTITUTES 734 Fairmount Ave. Pasadena, CA 91105 (213) 440-5436	Developed: the ventricular-peritoneal shunt, a surgical procedure, for the treatment of hydrocephalus; numerous cell culture models used in the screening of carcinogens and anticancer drugs; computerized tomography-referenced stereotactic neruosurgery and various neuroprostetic electrodes.	Mr. William Opel Mr. John Vogt
INSTITUTE FOR MEDICAL RESEARCH Copewood Street Camden, NJ 08103 (609) 966-7377	Conducted gamma-globulin field trials as first prevention of paralytic poliomyelitis. Developed antibiotic-free cell culture procedures, biohazard hood, and mycoplasma control methods. Is the National Repository for the Human Genetic Mutant Cell cultures and Aging Cell cultures. Conducts basic research in molecular biology of breast cancer, genetic diseases and environmental carcinogens.	Dr. Lewis L. Coriell Mr. S. Robert Wilson
THE INSTITUTE FOR MEDICAL RESEARCH 2260 Clove Drive San Jose, CA 95128 (408) 998-4554	Developed an oral drug for treatment of coccidioidomycosis (Valley Fever), a disease most prevalent in underdeveloped countries, thus eliminating the need for hospitalization for i.v. therapy. Developed analytical tools for the pharmacokinetic study of anticoagulant drugs. Isolated a chemical that induces Parkinson's disease in squirrel monkeys. For the first time, a laboratory model is available to study the prevention and therapy of this common debilitating disease of the aged. IMR is one of the 16 NIHR designated Handicapped Research Centers in the nation.	Dr. Richmond T. Prehn Ms. Stephanie Ferguson
INSTITUTE FOR RESEARCH IN SOCIAL BEHAVIOR 456 22nd Street Oakland, CA 94612 (415) 465-2791	Since 1966, IRSB has been engaged in a series of definitive studies designed to describe the extent and character of psychotherapeutic drug use in the United States. In other innovative research applications, IRSB has developed methods for obtaining informed public judgments regarding ethical issues in biomedical research.	Dr. Glen D. Mellinger Ms. Michaelene Skronski
THE JACKSON LABORATORY* Otter Creek Road Bar Harbor, ME 04609 (207) 288-3371	The Laboratory is a leading world center for mammalian genetics research. Its scientists are working in a number of areas including mammalian and molecular genetics, developmental biology, immunology, biochemistry, physiological genetics and cell biology. There are seasonal and year-round training programs for high school and college students, graduate students, and postdoctoral fellows. Its animal resources program distributes some two million inbred and mutant mice to researchers in the U.S. and abroad.	Dr. Barbara H. Sanford Mr. Paul J. Farr

W. ALTON JONES CELL SCIENCE CENTER Old Barn Road Lake Placid, NY 12946 (518) 523-2427	Investigates the cellular basis of disease through the application of tissue culture techniques and those of its protein chemistry and recombinant-DNA laboratories. Research is focused on previously unidentified hormone-like biological effectors produced by cells in culture.	Dr. Gordon H. Sato Mr. William S. Olney
JOSLIN DIABETES CENTER One Joslin Place Boston, MA 02215 (617) 732-2400	This group of laboratories is involved in a multifaceted approach to the study of diabetes and its complications. Recent studies of the biochemistry of the insulin receptor and immunologic aspects of diabetes have provided insight into some of the basic abnormalities in both Type I and Type II diabetes.	Dr. C. Ronald Kahn Ms. Constance A. Langone
THE LINDSLEY F. KIMBALL RESEARCH INSTITUTE 310 East 67th Street New York, NY 10021 (212) 570-3000	Research on blood related problems, including the development of new plasma derivatives for therapeutic transfusion. Discovered over half of all new blood factors found in the last 20 years. Successfully changed Group A and B blood to Group O blood. Prepared the first cryoprecipitate for hemophilia therapy and the first hepatitis B immunoglobulin. Proved the efficacy of hepatitis B vaccine.	Dr. Aaron Kellner Mr. Benjamin Leavitt
LOVELACE MEDICAL FOUNDATION 5400 Gibson Boulevard Albuquerque, NM 87108 (505) 262-7000	Performed for NASA the physiological evaluation and health maintenance of the original seven astronauts. Current research aims at the detection of coronary, heart and lung diseases and at instrumentation development for noninvasive measurement of cardiac output. Uses cell fusion techniques to produce proteins other than antibodies and develops monoclonal antibodies to stimulate plant growth.	Dr. David J. Ottensmeyer Mr. Leonard M. LeFevre
MEDICAL FOUNDATION OF BUFFALO, INC. 73 High Street Buffalo, NY 14203 (716) 856-9600	Found that a major component of the contraceptive pill and some components of the tobacco leaf inhibit estrogen synthesis and may therefore be useful in the treatment of certain breast cancers. Developed a rapid reliable test for fetal viability which is now widely used and which gives early warning of the need for caesarean section when necessary to save the baby's life.	Dr. George F. Koepf Dr. Herbert A. Hauptman
MEDICAL RESEARCH INST. OF SAN FRANCISCO 2200 Webster Street San Francisco, CA 94115 (415) 563-2323	Developed and implemented a computer-based patient monitoring system (representing the first use of artificial intelligence in an Intensive Care Unit in the country) and the Bramson-Stoker heart-lung machine. Pioneered a non-surgical treatment for the correction of Strabismus. Developed leukapheresis, the only known cure for hairy cell leukemia. Also is one of the nine NIAAA designated Alcohol Research Centers in the nation and one of the 16 NIHR designated Handicapped Research Centers in the nation.	Ms. Mary Woolley
MICHIGAN MOLECULAR INSTITUTE 1910 W. St. Andrews Rd. Midland, MI 48640 (517) 631-9450	Carries out studies on the initiation, development and maintenance of cancer from a cellular and molecular viewpoint. Alterations in DNA structure and function which contribute to tumor initiation and changes in the cell membrane and the cell matrix which contribute to the disease process are being investigated.	Dr. Cordon B. Carson

THE MONELL CHEMICAL SENSES CENTER 3500 Market Street Philadelphia, PA 19104 (215) 898-6666	Established the first multidisciplinary center of the senses of taste and smell. Discovered the first protein sweetener which helped in the understanding of receptor mechanisms. Has accumulated fundamental information on chemical senses which provide the bases for improved nutrition and population regulation, both in animals and humans.	Dr. Morley R. Kare Mr. Martin Bayersdorfer
ALTON OCHSNER MEDICAL FOUNDATION 1516 Jefferson Highway New Orleans, LA 70121 (504) 838-3000	First to demonstrate a trial natriuretic factor in man. Studies directed toward: hemodynamic assessment of cardiovascular consequences in hypertension; cellular biology of angiotensin system in vascular smooth muscle and cardiac cells; intestinal metabolism in shock; mechanisms of renal stone formation; factors related to experimental prostate and breast cancer and clinical oncological therapy.	Dr. Edward D. Frohlich Mr. William H. McFarland
OKLAHOMA MEDICAL RESEARCH FOUNDATION 825 N. E. 13th Street Oklahoma City, OK 73104 (405) 271-6673	Pioneered amino acid sequencing; first to model pepsinogen and gastrin; defined "families" of lipids and characterized apolipoproteins; demonstrated detoxification of carbontetrachloride; pioneering ESR for total function rather than cellular function; now expanding research and clinical use of mismatched marrow for transplants; preparing monoclonal antibodies to new group of antigens in lupus discovered here.	Dr. William G. Thurman Mr. J. Milton Smith
PACIFIC HEALTH RESEARCH INSTITUTE 800 S. King St., Suite 200 Honolulu, Hawaii 96813 (808) 524-4411	As a breast cancer detection center studies risk factors associated with that disease. Participates with 32 other centers in the beta blocker heart attack trial attempting to prevent sudden death in patients who have previously had an acute myocardial infarction. Studies ways of delaying or preventing postmenopausal osteoporosis. Evaluates the prospective health status of workers in Hawaii who are chronically exposed to chemicals in the wood industry.	Dr. Fred I. Gilbert Mr. Wally Izumigawa
PALO ALTO MEDICAL FDN. RESEARCH INSTITUTE 860 Bryant Street Palo Alto, CA 94301 (415) 326-8120	Developed a research resource and international referral center on toxoplasmosis, a world-wide disease that is an important factor in fetal mortality and a serious disease in infants and children. Bioengineering research provided a unique noninvasive method for assessing cardiac function after open heart surgery for coronary artery disease, insertion of valve prosthesis or cardiac transplantation. Economic research on health care costs and insurance.	Dr. Marcus A. Krupp Mr. Robert G. Lindee
PAPANICOLAOU CANCER RESEARCH INSTITUTE AT MIAMI, INC. P.O. Box 016188 Miami, FL 33101 (305) 324-5572	Basic research on tumor induction, metabolism and regression using techniques such as electron-microscopy, microspectrofluorimetry, nuclear magnetic resonance and X-ray diffraction. Co-organizer of the prestigious Miami Winter Symposia.	Dr. Julius Schultz Dr. H. Paul Meloche
PERALTA CANCER RESEARCH INSTITUTE 3023 Summit Street Oakland, CA 94602 (415) 451-2369	First to grow normal human mammary epithelial cells and human primary breast carcinoma cells in culture. Has an extensive repository of human breast specimens and cultured cells therefrom. Is developing monoclonal antibodies to mammary epithelial cells.	Dr. Adeline J. Hackett Mrs. Francine Lauderdale

PROFESSIONAL STAFF ASSOC. OF LOS ANGELES COUNTY 1739 Griffin Avenue Los Angeles, CA 90031 (213) 223-4091	Scope of research activities covers studies in all medical specialties, with special emphasis and interest in advancing the quality of health care. Current investigations include the areas of anesthesia, cardiology, gastroenterology, medicine, microbiology, neonatology, obstetrics/gynecology, ophthalmology, pediatrics, psychiatry, and surgery.	Dr. Sol Bernstein Ms. Marge Hulen
THE ROCHE INSTITUTE OF MOLECULAR BIOLOGY Nutley, NJ 07110 (201) 235-3681	Dedicated to basic research and training in biochemistry, genetics, virology, neurobiology, pharmacology, and other areas of molecular biology. Staff have complete independence in their choice and pursuit of research programs. Onsite training of nearly 500 Postdoctoral Fellows and 35 graduate students since the Institute's inception in 1967 has been an integral part of the programs' research mission and achievements.	Dr. Herbert Weissbach Mr. Richard L. Snyder
THE ROCKY MOUNTAIN HEART RESEARCH INSTITUTE 601 East 19th Avenue Denver, CO 80203 (303) 861-1627	Committed to heart and cardiovascular disease prevention. New "marker" angiographic catheters for diagnostic purposes and new "guiding" angioplastic catheters for treatment purposes reduce the necessity for bypass surgery.	Dr. Fred W. Schoonmaker Mrs. Karen E. Campbell
ELEANOR ROOSEVELT INST. FOR CANCER RESEARCH 4200 E. Ninth Ave., B129 Denver, CO 80262 (303) 394-7152	Measured the mean lethal dose of X-rays revolutionizing radiobiology. Made substantial contributions to the science of somatic cell genetics. Made critical contributions to the understanding of the phenomenon of reverse transformation and to the mapping of human genes.	Dr. Theodore T. Puck Dr. David Patterson
THE SALK INSTITUTE FOR* BIOLOGICAL STUDIES P.O. Box 85800 San Diego, CA 92138 (619) 453-4100	Biological research in the fields of molecular biology, immunology, cancer, neuroscience, and plant biology. Discovered several brain hormones including CRF, GRF, and Somatostatin; first successful transfer of functional gene from one mammalian species to another; development of rapid diagnostic procedures for diagnosis of viral infections. Four Nobel laureates on resident staff.	Dr. Frederic de Hoffmann Dr. Maxwell Cowan
SCRIPPS CLINIC & RESEARCH FOUNDATION 10666 N. Torrey Pines Rd. La Jolla, CA 92037 (619) 455-9100	Responsible for the development of synthetic vaccines, such as against foot and mouth disease, influenza, etc. and for the study of complement and other bodily defense mechanisms. Developed the technology required for the purification of blood coagulation factor VIII and for the processing of other such factors.	Dr. Frank J. Dixon Dr. Raymond H. Kahn
SOUTHWEST FOUNDATION FOR BIOMEDICAL RESEARCH P.O. Box 28147 San Antonio, Texas 78284 (512) 674-1410	Forty staff scientists and a number of scientists from affiliate medical schools and research institutions conduct basic research in aging, cardiogenesis, arteriosclerosis, obesity, hypertension, lung disease, perinatal problems, virology and immunology, genetics, organic chemistry and behavioral medicine. Much of the research uses nonhuman primates (baboons and chimpanzees).	Dr. Duncan Wimpress Mr. Edward F. Feith

TRUDEAU INSTITUTE, INC. P.O. Box 59 Saranac Lake, NY 12983 (518) 891-3080	Demonstrated the functional inter-relationships of the body's white cells in destroying bacteria. Defined the long-lived nature of the lymphocytes responsible for maintaining states of immunization. More recently revealed that cancer cells can cause the production of suppressor lymphocytes that turn the immune system off. Trudeau Institute continues to focus its research on elucidating the mechanisms of immunity to infectious diseases and cancer.	Dr. Robert J. North Mr. David P. Kirstein
VIRGINIA MASON RESEARCH CENTER 1000 Seneca Street Seattle, WA 98101 (206) 624-1144	Basic research in cell growth, organ transplantation, wound healing, neurological mechanisms involved in speech and hearing, tumor immunology — to prevent the spread of cancers — and respiratory physiology in chronic lung problems such as emphysema.	Dr. John Rasmussen
WHITEHEAD INSTITUTE FOR BIOMEDICAL RESEARCH MIT Cambridge, MA 02139 (617) 253-6455	A basic research laboratory with a special focus on understanding biological development. Has contributed to cancer research, immunology, molecular genetics, and cell physiology. Faculty include Dr. David Baltimore, Nobel laureate and Dr. Robert Weinberg, discoverer of altered genes in cancer cells.	Dr. David Baltimore Mr. John Pratt
THE WISTAR INSTITUTE* 36th & Spruce Streets Philadelphia, PA 19104 (215) 898-3700	Developed the first continuous human cell line in tissue culture and the rubella and human rabies vaccines. Is developing monoclonal antibodies for use in the treatment of melanomas and colonrectal carcinomas.	Dr. Hilary Koprowski Dr. Warren Cheston
THE WORCESTER FOUNDATION* FOR EXPERIMENTAL BIOLOGY, INC. 222 Maple Avenue Shrewsbury, MA 01545 (617) 842-8921	Developed the first oral contraceptive, now used by 60 million women world-wide. Has very active research programs in male reproduction and neurobiology. Has contributed substantial knowledge about insertional mutagenesis of oncogenes and basic studies of growth and differentiation.	Dr. Mahlon Hoagland Dr. Federico Welsch

OFFICERS 1984

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Automated Financial Systems, Inc.,
King of Prussia, PA, June 28, 1984.

Hon. Dan Rostenkowski,
Rayburn House Office Building,
U.S. House of Representatives, Washington, DC.

Dear Representative Rostenkowski: AFS is a small computer software development and marketing organization specializing in financial applications. I would like to express to you the benefits of the R&D tax credit to the continuing growth of the software industry.

Our organization has developed four new products in the last three years. These products have added employees and stability to AFS. This growth and stability has improved the industry which in turn benefits the economy.

In starting new products, we do not know if the completion will be successful, if the market place will accept the new concepts or if other conditions will prevent successful marketing. The computer software industry is a strong plus for our country which I believe is worth supporting with the R&D tax credit.

Sincerely,

James E. Greenwood,
President.

The Business Roundtable,
Washington, DC, July 27, 1984.

Hon Charles B. Rangel,
Chairman, Oversight Subcommittee, Ways and Means Committee,
U.S. House of Representatives, Washington, DC.

Dear Mr. Rangel: I am writing to express my support and that of the Business Roundtable for a permanent R&D tax credit for qualified research and experimentation expenditures. I ask that this letter be made part of the record for the hearings which your Ways and Means Oversight Subcommittee is holding on August 2 and 3.

The Business Roundtable believes that the roots of U.S. productivity increases and economic competitiveness lie in the capacity of the private sector to generate technological innovation. Research and development efforts are important determinants of innovation. While the United States continues to have the lead in basic research, indicators of R&D performance, such as the number of major world innovations or the number of U.S. patents granted to U.S. inventors, have been declining in the United States while rising in other countries.

The incentive system is critical to the process of innovation. The tax credit for increase research and experimental expenditures was enacted in 1981 as a relatively inexpensive provision to encourage American companies to invest in relatively high risk research and experimental activities. Such activities are essential in development of new manufacturing processes to improve productivity and in the invention and commercalization of advanced products. The R&D credit is an important incentive and should be made permanent. Efforts to restrict the definition of R&D for purposes of the credit must be approached with caution and with close consultation with the R&D establishment.

My personal support for the credit is based on the experience of the chemical industry in meeting competition worldwide. Strong emphasis on science and engineering—on both basic and applied research—has been characteristic of the chemical industry. It has led both to new products and the application of advanced technology in the manufacture of more mature ones. In the United States, for example, the chemical industry carries out a disproportionate amount of research. While it accounts for only 9 percent of U.S. manufacturing shipments, it does about 15 percent of all research and development carried out by industry and, in addition, some 35 percent of all basic R&D funded by industry. This strong emphasis on R&D helped the U.S. chemical industry remain a strong worldwide competitor, generating 36 percent of world chemical sales and a $9 billion trade surplus in 1983, despite problems associated with an overvalued U.S. dollar.

There is concern that Congress will allow the R&D tax credit to expire on December 31, 1985 or extend it for a given number of years rather than make it permanent. If the credit is to have a maximum effect, the business community must have some assurance that the credit will be available in future years where commitments with a long lead time are made. Thus, the start of new projects isn 1985 could be delayed if there were no assurance that the credit would continue to be available after 1985.

The Business Roundtable strongly supports efforts to reduce the federal deficit. However, we are also committed to sound tax incentives which make industry and our country more productive and competitive worldwide.

Sincerely,

E.G. JEFFERSON,
Chairman, Taxation Task Force.

COMPUTER FINANCIAL CORP.,
Evanston, IL, July 26, 1984.

Congressman DANIEL ROSTENKOWSKI,
Rayburn House Office Building, Washington, DC.

DEAR CONGRESSMAN ROSTENKOWSKI: Our company has successfully financed the expansion of several "high-tech" companies, primarily with the leverage of the R & D tax deduction. Over one hundred new jobs were created in the Chicago area, financed by these partnerships. As you may know, provisions of the 1984 tax bill will kill the research and development partnership structure.

Shouldn't public policy reward job creation and development of new products? Shouldn't the United States give greater support to its R & D efforts, like Japan has?

Please try to change those provisions of the tax bill which prevent R & D deductions from exceeding the initial cash investment. Let us know your thinking regarding this important matter.

Very truly yours,

GEORGE B. FINK,
President.

STATEMENT OF THE CONSORTIUM OF SOCIAL SCIENCE ASSOCIATIONS

Mr. Chairman, the Consortium of Social Associations (COSSA) is pleased to have the opportunity to submit the following testimony presenting our views on the tax credit for Research and Experimentation (Sections 221 and 222) of the Economic Recovery Tax Act of 1981 (ERTA). The Consortium represents 175,000 scientists across the full range of the social and behavioral science disciplines. A full list of COSSA Members, Affiliates and Contributors is attached to this testimony.

COSSA would like to comment on two sections of the tax act concerning the credit: (1) the exclusion of the social sciences from the Research and Experimentation tax credit; and (2) the exclusion of the social sciences from qualifying for the use of donated scientific and technical property.

(1) The exclusion of the social sciences from the Research and Experimentation tax credit limits the effectiveness of the legislation. Congress has expressed its desire that the United States help industrial research and development generate new high technology industrial products to promote economic growth in this country. One means of doing so is the tax credit for new Research and Experimentation in ERTA. However, the process of creating and employing new technologies is not merely mechanistic; it is also an inherently social process that depends heavily on human factors as well as machines. The development of new technologies is a product of both human and physical components. Social science research informs us about these human factors.

There are many examples of the impact of social science research on improved productivity and better products. Human factors research in aviation and power plant design have contributed to improved design and placement of gauges and controls for maximum readability and efficiency of control. These are critical elements because many lives and millions of dollars in equipment depend upon rapid and accurate human judgment and performance. For example, cockpit design problems in the F-18 fighter aircraft were corrected on the basis of findings of social science research. In addition, social science experiments on worker productivity and quality control have led to effective techniques, utilized extensively by the Japanese, for linking participative decisionmaking and the acceptance of innovations in the workplace.

Social science research is critical in the development of several major high technology areas such as robotics, where social scientists study human factors in the design and operation of industrial robots and the impact of robotics on worker morale and productivity, on unemployment, and on labor market dislocations. Another area where social scientists play a vital role is in the research on artificial intelligence in the development of supercomputers. Social scientists also contribute to the assessment of long-term risks associated with new technologies and to understanding the most efficient and productive environments for technological innovation. Finally, it is clear that the future use of new technological products will be as constrained by workers' skills, mobililty, and adaptability—all studied by social scientists—as by the availability of investment capital and technological quick-fixes.

Einar Thorsrud, Director of the Work Research Institute of Norway, testified at hearings held by the House Subcommittee on Science, Research and Technology that the stimulation of new technologies requires "problem oriented research," where scientists are drawn together irrespective of discipline in "concrete collaboration . . . each bringing their contributions to solve complex problems." This collaboration cannot be achieved without expanding the industrial research and experimentation tax credit to include research done by social scientists.

(2) The Congress has made clear its desire to help institutions of higher education modernize their equipment and facilities for training the country's new scientists and has provided for a tax credit for the donation of scientific equipment to universities. The social sciences are again excluded from this provision. However, research and training in the social sciences involves sophisticated methodologies and statistical approaches. These are fundamental for scientific research in all fields and at the same time contribute to our understanding of economic and technological development. Much of the equipment donated by industry to universities under this provision of the tax credit is in the general field of computers, which are used extensively by social scientists. For example, at the University of Michigan, some 35 percent of the total funded research usage at the university's computing facility is for research in the social sciences. Proportionally, social scientists use these computers almost as much as the natural and physical scientisits use them. It does not make sense to cut off whole disciplines, disciplines that depend on computers for research that contributes to economic development, from sharing in the provisions of the tax credit.

For these reasons we request that as the debate continues on the extension of the research and development tax credit, that the definition of qualifying research, rather than being further restricted as in the Senate passed provisions of H.R. 4170, should be expanded to include the social sciences.

CONSORTIUM OF SOCIAL SCIENCE ASSOCIATIONS

MEMBERS

American Anthropological Association.
American Economic Association.
American Historical Association.
American Political Science Association.
American Psychological Association.
American Sociological Association.
American Statistical Association.
Association of American Geographers.
Association of American Law Schools.
Linguistic Society of America.

AFFILIATES

American Association for Public Opinion Research.
American Educational Research Association.
American Society of Criminology.
Association for Asian Studies.
Eastern Sociological Society.
Economic History Association.
Evaluation Network.
Evaulation Research Society.
History of Science Society.
International Communication Association.
International Studies Association.
Law and Society Association.
Midwest Sociological Society.
National Council on Family Relations.
North Central Sociological Association.
Northeastern Anthropological Association.
Population Association of America.
Regional Science Association.

Rural Sociological Society.
Social Science History Association.
Society for American Archaeology.
Society for the History of Technology.
Society for Research in Child Development.
Society for the Scientific Study of Religion.
Society for Social Studies of Science.
Southwestern Social Science Association.

CONTRIBUTORS

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Center for International Studies, Duke University.
University of Colorado.
Columbia University.
Cornell Institute for Social and Economic Research.
Cornell University.
Florida State University.
Harvard University.
University of Illinois.
Indiana University.
Institute for Social Research, University of Michigan.
University of Iowa.
The Johns Hopkins University.
University of Michigan.
University of Missouri.
University of Nebraska.
New York University.
Ohio State University.
University of Oregon.
University of Pennsylvania.
University of Pittsburgh.
Princeton University.
Rutgers University.
Social Science Research Council.
University of Southern California.
Stanford University.
State University of New York at Stony Brook.
Texas A & M University.
Tulane University.
University of Washington.
University of Wisconsin, Madison.
University of Wisconsin, Milwaukee.

THE FOXBORO CO.,
Foxboro, MA, August 21, 1984.

Hon. CHARLES RANGEL,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, Longworth House Office Building, Washington, DC.

DEAR MR. CHAIRMAN: My name is Charles A. McKay and I am Executive Vice President and Corporate Director of Technology for The Foxboro Company, which is headquartered in Foxboro, Massachusetts.

The Foxboro Company designs, manufactures and markets high technology instrumentation systems, and other related products and services for the management and control of industrial processes. The Company employs approximately 10,000 persons and is international in scope, with manfacturing facilities in 9 countries and sales and support centers in 17 countries. In 1983, Foxboro's net sales totaled $533.1 million. Of this amount, approximately fifty percent represented products sold outside the United States.

Foxboro is engaged in a highly competitive worldwide business. Its competitors include full-range as well as specialty suppliers both U.S. and foreign based.

In order to maintain a worldwide competitive edge, it is essential that The Foxboro Company continue to provide a level of product sophistication which responds to the increasing technological requirements of the marketplace. Truly, research and development is the life blood of my company.

In these difficult economic times, with incoming order rates down, shipments down, and profits down, there is very strong pressure to cut costs of all types, including R&D expenditures. The R&D tax credit has proved to be an effective tool which I have used successfully in my efforts to increase our research and development activities.

During the last three years Foxboro's R&D expenditures have steadily increasesd despite a corresponding decline in sales over the same period (Exhibit A). The R&D tax credit has played a significant role in our company's ability to increase levels of R&D spending in the face of declining profits. In fact, our R&D expenditures were about 15% more in both 1982 and 1983 than they would have been without the credit.

Specifically, I'd like to point out two projects which I feel were approved due to the existence of the R&D tax credit. These projects are (1) a $4 million Micro-Technology Center; and, (2) a custom LSI Design Project. These projects represent ventures into brand new technologies and were in serious jeopardy due to budget constraints. Approval of these projects were in large part due to benefits which would be gained from the R&D credit which had a favorable impact on our return on investment computations.

In addition to stimulating additional spending, the R&D credit, coupled with the suspension of Treasury Regulation 1.861-8, has encouraged us to concentrate our spending in the United States.

For many years, R&D tended to centralize all of its R&D efforts in the United States. However, in 1980 a decision was made to establish a European R&D operation. The Foxboro Company now has R&D activities underway in its subsidiaries in both the Netherlands and the United Kingdom as well as in the United States. Our reasons for relocating these activities were a combination of shortages of key technical skills in the United States, U.S. tax penalties, and other factors. We already had a support infrastructure in place in Europe and have found no difficulties in directing and coordinating this activity from the United States, thanks in part to the ease of communications vis telephone, telex, computer links and personal visits. Thus, the decision to expand R&D operations abroad rather than in the United States was from a business point of view entirely feasible and from a tax point of view clearly advantageous.

Despite continued pressures from our European technology group and overtures from other foreign subsidiaries, spurred by foreign government incentives (see attached memoranda), The Foxboro Company has taken affirmative steps to limit its overseas spending, concentrating its R&D efforts in the United States in order to benefit from the R&D credit. In 1983, for example, only $1.8 million was spent overseas which equates to 3.9% of our total R&D spending of $45.9 million. Certainly, if the R&D credit is not made permanent, this decision will be reexamined.

I strongly believe that it is necessary to maintain, and even increase the levels of R&D spending in my Company if we are to continue to meet our competition from here and abroad. New products and new developments do not materialize overnight. Competitive high technology products are a result of an evolutionary process which requires the efforts of significant numbers of talented technical people. Thus, The Foxboro Company is faced with an ever increasing need for still greater resources to devote to R&D. The R&D tax credit is helping to meet that need, and we strongly support legislative efforts which will make the credit available to us on a permanent basis.

Very truly yours,

CHARLES A. MCKAY,
Executive Vice President.

Enclosures.

EXHIBIT A

[All dollar figures, other than the R&D credit, are thousands of dollars]

Year	Sales	R&D expenditures	R&D as a percent of sales	R&D credit
1981	$606,870	$36,913	6.1	$850,871
1982	603,437	43,750	7.3	1,632,907
1983	533,102	45,894	8.6	1,735,403

The Ministry of Economic Affairs

Industrial Commissioner of the Netherlands to the United States

One Rockefeller Plaza
New York, NY 10020
Telephone: (212) 246-1434
Telex: 125240

601 California Street
San Francisco, CA 94108
Telephone: (415) 981-1468
Telex: 171061

2200 Post Oak Boulevard
Houston, TX 77056
Telephone: (713) 552-0175
Telex: 795303

New York
August 23, 1983

RECEIVED
AUG 26 1983
TAX DEPARTMENT

Mr. Paul Cherecwich Jr.
Corporate Tax Manager
THE FOXBORO COMPANY
38 Neponset Avenue
Foxboro MA 02035

Dear Mr. Cherecwich:

Thank you for your letter of July 22 and I apologize that you have not received a reply until now - vacations always create some problem in a small office.

However, I have enclosed a description of the technical development loans referred to in the March 16 issue of "INSIDE R & D, THE WEEKLY REPORT ON TECHNICAL INNOVATION". This program has been in effect for some 25 years in the Netherlands, and has been used successfully by many companies.

I hope this information will give you an insight into how this program works - if you would like additional information, please call me. In addition, your subsidiary in the Netherlands could contact the Ministry of Economic Affairs in the Hague about this and they should talk to either Mr. Giessen or Mr. Heerkens.

Sincerely,

Frits Wijn
Deputy Industrial Commissioner

FW:p
83-1213
Enc.

To G. F. Morris, D. 110

From P. Cherecwich, Jr., D. 111

File European R&D

Subject Dutch Development Incentives

Date August 29, 1983

Copies C. A. McKay, D. 110
J. W. Bernard, D. 100

The Dutch government offers 5% interest loans for development work. Attached are a set of guidelines I obtained from the Industrial Commissioner of the Netherlands to the United States. John Bernard originally spotted reference to this program in a newsletter he reads.

This program looks like it might be useable by Foxboro Nederland, provided it were for a product which could be developed and manufactured exclusively in Soest. The nice thing about this loan program, in addition to the 5% annual interest rate, is that the loan is forgiven if the product does not sell.

Please advise, if you would like to pursue this further.

Paul Cherecwich, Jr., D. 111
PC/jc

To P. CHERECWICH JNR. D.111 FOXMASS

From J. R. BOAG - LILYDALE, AUSTRALIA

File INDUSTRY RESEARCH & DEVELOPMENT GRANTS

Subject SYSTEMS PROJECTS

Date 20TH AUGUST, 1983

Copies R. J. McINNES - LILYDALE

RECEIVED
SEP 7 1983
TAX DEPARTMENT

Paul,

You may not be aware that there are certain incentives for industrial research and development in Australia which result mainly in cash grants, providing various rules are followed.

Robert McInnes has suggested that there are a number of projects in the Systems area which could be performed at Lilydale, and if so, could result in us obtaining I.R.& D. grants.

The Labour governments, both Federal and State, are very keen to promote high technology in Australia and are making it easier to obtain funds to develop suitable programs.

It seems that although senior management at Foxboro has agreed in principal that Lilydale people could provide a Corporate service by carrying out various development work, it seems that the middle management area in the United States has bogged down decisions which should be made before we can commence doing anything.

In view of the possibility of receiving I.R. & D. grants, is there anything you could do to assist us in initiating some type of program?

Regards,

S. Rawson

p J. R. BOAG

JRB/sr

INSTITUTE FOR MEDICAL RESEARCH,
Camden, NJ, July 31, 1984.

Hon. CHARLES RANGEL,
Chairman, Oversight Subcommittee,
Longworth Building, Washington, DC.

DEAR CHAIRMAN RANGEL: I would like to commend the Oversight Subcommittee for holding hearings on the research and development tax credit. This is an extremely important area for the nonprofit scientific research organizations in this country.

As you know, we have not requested the opportunity to testify before the Subcommittee during these hearings. However, we would like to go on record in support of the continuation of the eligibility of contracts with nonprofit scientific research organizations being eligible for the 25 percent incremental research and development tax credit as enacted in 1981.

We are presently conducting a survey of nonprofit research organizations throughout the country to gauge precisely how this tax provision is being utilized. We will share with the Subcommittee the findings of our survey as soon as they are available.

In addition, we would like to go on record in support of enactment of H.R. 3814 which would make donations of scientific equipment to nonprofit scientific research organizations eligible for the special charitable contribution provisions, as has been done for universities and colleges.

If we can provide you with any additional information or answers to any questions you may have, please do not hesitate to contact me.

Sincerely,

LEWIS L. CORIELL, M.D., Ph.D.,
President.

INTERNATIONAL UNION, UNITED AUTOMOBILE, AEROSPACE &
AGRICULTURAL IMPLEMENT WORKERS OF AMERICA—UAW,
Washington, DC, July 10, 1984.

Hon. CHARLES RANGEL,
Chairman, Subcommittee on Oversight,
Committee on Ways and Means,
U.S. House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: Although it will not be possible for the UAW to testify during hearings before your Oversight Subcommittee concerning the 25 percent tax credit for incremental research and experimentation expenses, we wish to express our opposition to continuation of this tax credit. We urge that it be allowed to sunset at the end of 1985 when it is currently scheduled to expire.

The UAW opposes the R&D credit for two reasons:

First, continuation of this tax credit would entail a substantial loss of revenue to the federal government. It has been estimated that it would result in a net revenue loss of $1.666 billion and $4.923 billion by the end of fiscal year 1987 and 1989, repectively. Given the magnitude of the budget deficits projected for the rest of the decade and the threat to our economic health represented by those deficits, the UAW does not believe it makes sense to aggravate the problems by continuing a program of tax expenditures for corporations. It would also be highly inequitable, in light of the drastic budget cuts that have been made and are being proposed in social programs.

Second, in our judgment the R&D tax credit is not an effective or efficient means of stimulating needed research and development expenditures by the private sector. Companies are able to reap the benefits of the tax credit for expenditures that would have been incurred in the normal course of business.

The UAW believes a better approach would be for the federal government to target assistance to specific firms, projects, and universities through a program of grants administered by a "National Civilian Technology Administration." In this manner, assistance could be directed where it is truely needed in order to develop new technologies to make the U.S. economy more competitive and productive. In addition the assistance could be structured so that there is some assurance it would lead to job-creating investment in the United States, rather than being diverted into overseas production and profit.

For the foregoing reasons, the UAW opposes continuation of the R&D tax credit. This tax credit should be allowed to expire as scheduled after December 31, 1985.

We respectfully request that this communication be made a part of your hearing record.

Sincerely,

Dick Warden,
Legislative Director.

STATEMENT OF THE MACHINERY & ALLIED PRODUCTS INSTITUTE

Introduction

The Machinery and Allied Products Institute (MAPI) is pleased to have this opportunity to present its views in public hearings to the Subcommittee on Oversight of the House Committee on Ways and Means concerning the 25 percent tax credit for certain incremental research and experimentation (R&E) expenditures, as authorized by Section 221 of the Economic Recovery Tax Act (ERTA) of 1981 and now established as Internal Revenue Code Section 44F.

The Institute

As the Subcommittee may be aware, MAPI is the national organization of manufacturers of capital goods and allied products. In that capacity, the Institute represents industries manufacturing and marketing the facilities of production, distribution, transportation, communication, and commerce. MAPI's membership includes corporations in a number of the most research-intensive industries in the United States, such as, machinery, including office, computing, and accounting machines; electrical and electronic equipment; professional and scientific instruments; motor vehicles and related equipment; aircraft and missiles; and chemicals and allied products.

Role of R&E.--The Institute's member companies produce highly engineered--often state-of-the-art--goods that are sold worldwide. Technological advancement is essential to the survival and growth of such companies. More specifically, a continuing commitment to R&E is fundamental to their ability to open and enlarge markets, create meaningful employment, secure the defense, and achieve other useful purposes. In our opinion, research and experimentation is the "cutting edge" of U.S. technological progression which, in turn, is the engine driving the world's most dynamic economy. We think it is understandable that the Subcommittee should want to know how the new research tax incentive is working.

Our purpose.--Our purpose on this occasion is to try to provide informed views in response to the subject at hand, including questions raised in Subcommittee Press Release No. 18 of June 4, 1984, as revised on July 3, 1984. Part of our information is from government sources, but most of it is of private origin derived from discussions with executives of MAPI member companies. Inasmuch as certain conclusions we reach are at variance with ones embraced by Mansfield/1 and Eisner/2 in recent studies, we will allude to their findings and comment on several of the differences.

Summary Responses

With respect to questions raised in Press Release No. 18, our summary responses are as follows:

1. The R&E tax credit should be made permanent, with consideration given to such changes as will enhance the incentive effect while sharpening the definition of qualified expenditures.
2. The credit operates to stimulate additional R&E expenditures, but could be made more effective for that purpose. Such changes to the credit obviously would have to reflect the national priority assigned to R&E and the current budgetary limitations.
3. The types of expenditures and industry activities that have generated use of the R&D tax credit are predominantly "applied" kinds of research, with the greatest utilization in industries represented by MAPI. Questionable classifications/3 are believed to be negligible, estimated by some sources to be on the order of 4 percent of the total.
4. The categories of qualifying R&E expenditures should be changed to more nearly approximate those identified in generally accepted accounting principles, while sharpening the delineation between qualifying and non-qualifying expenditures to facilitate administration by government and taxpayers.

1/ "Public Policy Toward Industrial Innovation: An International Study of Direct Tax Incentives for R&D," by Edwin Mansfield, University of Pennsylvania, March 1984.

2/ "Tax Incentives and R&D Expenditures," by Robert Eisner, Stephen H. Albert, and Martin A. Sullivan, Northwestern University (Evanston, Illinois), September 1983.

3/ That is, ones that do not completely or obviously fit the existing definition in Code Section 174.

5. There has been some difficulty at the "boundaries" of the R&E definition in distinguishing between qualifying research expenditures and non-qualifying research-related expenditures. This is a normal phenomenon, but the definition could be rearticulated to reduce the margin for error. (See answer to Question 4.)

6. The base period computation rules could be simplified and/or made to have a more positive impact on increasing research and experimental expenditures.

7. Considering the importance of innovative activity, a credit and tax deduction should continue to be available for the same research expenditures.

8. The impact of the provision on federal revenues is a function of the definition of qualifying expenditures, the computation of the credit, the extent of compliance, and the effect of tax credit-induced R&E in generating taxable income that otherwise may not be realized.

9. The R&E tax credit in all probability has increased total industry spending on research above levels that would have been experienced in the absence of the credit, but we know of no evidence to indicate clearly whether allocations within research expenditure budgets have been changed.

10. Present law rules appear to be accomplishing congressional intent, consistent with the concepts adopted and limitations imposed, but the diversion of national resources to the research effort may in retrospect not seem as forceful as Congress originally intended. As constituted, the credit is circumscribed and targeted, to limit revenue loss and focus the tax benefit on incremental spending.

11. The credit should be continued on a permanent basis with some redefinition of "qualifying expenditures" to facilitate administration by government and taxpayers. Other changes to enhance the effect of the credit should be considered consistent with budgetary limitations.

Our further thoughts on the R&E tax credit are set forth herein following a brief background note.

Background

The R&D Credit

As partly explained in Press Release No. 18, Section 221 of the Economic Recovery Tax Act of 1981 provides for a 25 percent tax credit for certain qualified research expenditures paid or incurred by a taxpayer in carrying on a trade or business. Qualified research expenditures generally consist of "in-house" expenditures by the taxpayer for research wages and supplies used in research, plus certain amounts paid for research use of laboratory equipment, computers, or other personal property, and 65 percent of certain amounts paid for contract research and basic research grants to universities and scientific research organizations. The credit applies to expenditures made after June 30, 1981, and before 1986, and is applicable to incremental expenditures above a base period amount that is the average of certain previous years' expenditures.

Reportedly, at least 10 countries have adopted research tax credits or similar allowances since the mid-1960s in order to encourage research and experimental activity.

Recent R&E Spending

Calendar year 1982 was the first full calendar year influenced by the credit. According to the National Science Foundation (NSF),/1 the recession notwithstanding, companies' own financing of research and development activities grew 13 percent (7 percent in constant dollars) to $40 billion in 1982./2 The industrial sector, the largest performer of research and development in the United States, accounted for over 70 percent of total U.S. research and development outlays.

Together, company and federal funding of industrial research and development reached nearly $60 billion in 1982, 14 percent above the previous year's total in nominal dollars and 7.5 percent in constant 1972 dollars. This was significantly higher than the 5.5 percent average annual growth rate recorded between 1975 and 1981, according to NSF. In part, the boost was attributable to Department of Defense contracts for military aircraft and advanced weapons systems.

As noted, companies' own financing of R&D activities was significantly higher in 1982 than in 1981. NSF states that, although

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1/ Science Resources Studies: Highlights, National Science Foundation, NSF 84-314, Washington, D.C., May 14, 1984.

2/ It should be noted that "research and development" for statistical compilation purposes by the Bureau of the Census (as reported by NSF) differs somewhat in its meaning from "research and experimentation" as defined in the tax law. For purposes of this background discussion and the trends indicated thereby, the variations probably are of negligible consequence.

frequent budget trimming by companies was commonplace during the recession, research and development programs appear to have fared relatively well./1 NSF goes on to indicate that, according to industry officials, management is increasingly aware of the important contribution research and development has made to improving productivity. In addition, such officials are said to have cited the favorable tax treatment afforded research and development expenditures as helping to insulate such programs from attempts to cut items often considered discretionary outlays, such as marketing expenses./2

Commission on Industrial Competitiveness

Although a certain, few academicians disagree, the Reagan Administration, the business community, and numerous other observers believe that the research credit has been beneficial to date as an incentive to industrial innovation, and is a positive force for U.S. competitiveness in international trade.

The most distinguished group to have studied the issue thus far is the President's Commission on Industrial Competitiveness, chaired by John A. Young, President of Hewlett-Packard Corporation of Palo Alto, California. In a press release earlier this year,/3 the Commission offered several research and development and international trade recommendations, among which was one to make permanent the current incremental tax credits for research and development; broaden the definition of R&D to make it consistent with generally accepted accounting principles; and institute certain other measures to encourage industry investment in university research. In an accompanying fact sheet, the Commission stated in relevant part as follows:

1/ This statement of NSF is borne out by additional study conducted by MAPI and resulting in a publication entitled "Industrial R&D Spending: A Recession-Proof Phenomenon This Time Around," MAPI Memorandum G-159, December 1983.

2/ This statement should not be construed to suggest that "marketing expenditures," as such, are being reported to Census as research and development or to IRS as R&E activity. However, the logical progression of research activity in the industrial and commercial setting is from the laboratory to the prototype and, thence, to production. The research engineer may be called upon to assist in the development of a proposal for the adaptation of his findings to a potential customer's needs, in which case he arguably--in the minds of some--is as much engaged in marketing as in basic or applied intellectual inquiry.

3/ "Presidential Commission Would Increase U.S. R&D Efforts and Promote International Trade," President's Commission on Industrial Competitiveness, February 6, 1984.

> Tax credits are an important incentive for R&D. The Commission favors prompt enactment of legislation to make the current incremental tax credit permanent. The desirability of converting to a credit based on total R&D should be investigated. In such legislation, the definition of R&D eligible for the credit should encompass all activities traditionally accepted by standard accounting principles as R&D. Also, impediments to tax credit eligibility by start-up firms and joint ventures should be removed.
>
> The temporary moratorium against implementation of a regulation requiring allocation of domestic R&D expenditures to foreign source income (IRS Regulation Sec. 1.861-8) should also be made permanent./1
>
> The public benefits which come from research in universities would be increased by additional industry involvement with such research. The Commission therefore favors legislation creating a preferential tax credit to encourage industry investment in university research.

The 98th Congress

Legislation to carry out the recommendations of the Commission was, in large part, favorably acted upon by the Senate in the current Congress; was not acted upon by the House of Representatives; and, in the final analysis, was dropped from the recently enacted Tax Reform Act of 1984 because House conferees took issue on grounds of (1) estimated revenue cost, and (2) procedural "irregularity" inasmuch as the House Committee on Ways and Means had not conducted hearings on the subject (in spite of its high priority and repeated requests for Committee action). For reasons discussed later, the research credit can be improved in at least two ways--both of which were attempted in the Senate-passed version of the Tax Reform Act of 1984--without a significant loss of revenues to the Treasury.

Mansfield et al

The Mansfield and Eisner reviews mentioned earlier examined the impact of the research tax credit and concluded that it has had only a modest effect, even taking into account the outside limit of the statistical confidence interval (e.g., according to one study, resulting in an estimated 1.8 percent R&E increase, or $638 million, for 1983). Also, the reviewers speculated that the credit probably has cost more in terms of revenue loss than the extra amount of research so induced (i.e., an estimated $638 million of extra research induced in 1983 versus an estimated $1 billion revenue loss). Mansfield further asserts

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1/ The temporary moratorium in question was extended for two years by Section 126 of the Tax Reform Act of 1984, which, in turn, is part of the recently enacted Deficit Reduction Act of 1984, (Public Law 98-369, signed July 18, 1984).

that there are biases in his survey which, when taken into account, would show the credit to be even less useful than the data would suggest. These biases are said to be the predisposition of the management survey respondents in favor of the research tax credit, and the likelihood of statistical contamination resulting from an alleged misclassification of expenditures to increase the reportable credit (such misclassification estimated at 4 percent for the years 1982-83).

Among the reasons given by Mansfield for his finding that the credit has little effect are that (1) current research of some firms does not surpass the base period history, in which case the credit has no effect; (2) some companies have no current tax liability and, hence, are left with a carryforward of the credit; (3) because of the moving base period and the "ceilings," the after-tax price of an extra dollar worth of R&E is not reduced by 25 cents, as might be implied by the statutory credit rate, particularly when discounted to present value;/1 and (4) the price elasticity of demand for research and development is low, according to a study of R&D in the Bell System prior to its breakup./2

The findings of the Eisner study do not differ significantly from those of the Mansfield work, with the exception that Eisner and associates alleged that, under certain circumstances, the moving base period can cause the credit to have some "fairly bizarre" or "perverse" results. The Eisner examination also took into consideration, in greater detail than the Mansfield presentation, effects of inflation and economic cycles.

Treasury Proposals

As noted in the Mansfield study, Treasury officials, during 1983 and 1984, supported a three-year extension of the research credit so that firms would be able to plan their longer-range funding of R&D activities with more certainty than otherwise would be occasioned in view of the "sunset" of the credit at year-end 1985. Concurrently, Treasury recommended other changes, specifically, (1) that R&D activities that qualify for the credit should be defined more precisely; (2) that the base level of expenditures used to compute the amount of the credit should be indexed so that credits are not awarded merely for keeping up with inflation; and (3) that the credit should be altered to benefit start-up companies that frequently do not have any income tax liability against which to apply the credit.

1/ To include companies affected by reasons (1), (2), or (3) in a survey of the credit's effectiveness seems somewhat misleading in that the ineffectiveness or reduced impact in such cases was intended by Congress.

2/ MAPI is aware that R&D has some inelasticity. However, we question whether a supposedly disinterested analysis should rely on the R&D characteristics of an organization that was a regulated monopoly when studied.

The Mansfield work does not so state, but a Treasury official also indicated in one presentation to a Senate subcommittee,/1 in response to questioning from Senator Heinz of Pennsylvania, that Treasury was concerned for, and would give consideration to changes in the credit to accommodate, companies that necessarily must continue their research activity but derive no current benefit as a result of net operating losses.

Issues Posed by the Subcommittee

The commentary that follows is directed to the eleven issues raised by the Subcommittee on Oversight in Press Release No. 18. Of necessity, we also deal with certain aspects of the Mansfield and Eisner studies inasmuch as they purport to be credible examinations of the question at hand and conclude that the research credit is of little value.

As our views to follow will indicate, we find the research credit to be useful tax policy in the national interest. Furthermore, such "shortcomings" as the credit may have are a result of design trade-offs that were known at the time of enactment and reflected policy determinations and fiscal constraints then applicable.

In General

We begin with observations concerning the studies conducted by Mansfield and Eisner inasmuch as they may prejudge the issue before the Subcommittee unless certain weaknesses are exposed.

"Aberrations."--First of all, and perhaps most importantly, both studies dwell at length on alleged credit "aberrations" that could result from fluctuating research expenditures, due mainly to the rolling three-year base period with a built-in ceiling. Contrary to the implication of both studies, no one familiar with the credit and its formulation is surprised that it works as it does. The decision to enact an incremental credit with a rolling base period was deliberate so that taxpayers would qualify only if they exceeded their base period history, and would qualify year-after-year only if their research expenditures increased more or less indefinitely. This was done so that research that otherwise presumably would have been performed in any event would be less likely to trigger the benefit and, hence, the thrust of the incentive would be felt at the "margin." Another important reason for the incremental approach was to limit revenue loss, a purpose shared by the 100-percent-of-base cap.

1/ See hearings of the Senate Finance Subcommittee on Taxation and Debt Management, May 27, 1983.

The persons who formulated the research credit also were aware that persons without tax liability would not benefit from the research tax credit. Whether wise or not in retrospect, Congress did not make the credit refundable although the question was fully considered. Similarly, Congress did not overlook the possibility of having a fixed base period, as compared to having a moving, company-specific base period, for all companies, and did not overlook the possibility of indexing the base period so that inflationary increases alone in the cost of research would not lead to credit eligibility. Certain of these matters (e.g., refundability) were disposed of on grounds of revenue cost and--to a lesser extent--practical considerations with respect to the then-desired limits of "industrial policy" in the tax context.

Put another way, the research tax credit was deliberately designed to force taxpayers to "run faster and faster" if they were to obtain their reward. None of the "aberrations" described in the Mansfield or Eisner surveys were unforeseen. Furthermore, in order now to give the credit more of an incentive effect, Congress would once again have to take into consideration the estimated revenue losses associated with changes to bring that about. Having mentioned estimated revenue losses, let us add that the figures generated by Treasury are static rather than dynamic because it is difficult to project with any accuracy the extent of feedback revenues from research effort./1 This is not to say, however, that such revenues do not exist, and one might conclude to the contrary in view of the national priority placed on the encouragement of innovative activity. It is perhaps fair to state that the revenue losses may not be the magnitude indicated even though precise amounts cannot be shown.

Years studied.--On other aspects of the two surveys, we should mention that the years studied were unusual, encompassing the worst recession to take place in the United States since the Great Depression of the 1930s. Even with some price inelasticity of demand for research, one wonders about conclusions drawn from the experience of a severe recession. For example, it seems likely that many of the firms surveyed during the slack years would have had a relatively high base period. One wonders what reliable conclusions could be drawn about the incentive effect of the research credit during years of generalized stagnation in industrial markets. Why did the investigators state that the responses may have been self-serving and skewed by misclassifications if the

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1/ In the matter of Regs. 1.861-8 as it pertains to R&E allocation and apportionment to income within and without the United States, Treasury has contended--in the course of a long and acrimonious proceeding not yet completed due to a congressionally imposed moratorium--that current U.S.-based R&E generates income everywhere the taxpayer operates, and does so immediately. This is doubtful as a general proposition, and is inconsistent with one of the assumptions underlying the revenue estimates given for the R&E credit.

credit was unavailable to many companies and without substantial value to the rest, as alleged? Why should one think that there was a significant misclassification of expenditures when some executives reportedly doubted that tax allowances have any bearing on the level of research expenditures?

Persons surveyed.--As to those persons who were surveyed, some market-oriented executives rarely ascribe any importance to tax incentives. On the other hand, persons directly engaged in business investment management tend to be painstaking in their attention to anticipated costs and anticipated returns; are aware of the element of relief provided by a tax credit; and know the extent to which such financing enables a project to meet hurdle rates for return on investment or other criteria for project selection. In other words, survey results may vary according to the respondents, some of whom will be better equipped than others to answer the questions. If time would permit, we would be interested to know the roles of the corporate personnel who responded to the surveys; the nature of inquiries in the mail questionnaires; the content and thrust of interview questions that were used where mail questionnaires were not; further information about sampling errors and the confidence interval; sample stratification; sample substitutions; and other aspects of the procedure followed.

Revelations and inclinations.--To return to a theme pursued earlier, we find a certain naivete in the surveys' "revelations." Research credits and allowances are not new; each country that has adopted them has done so after careful analysis; the design attributes have been deliberate and adopted with foreknowledge of their consequences; and the only surprises are those of persons new to the subject or predisposed to a negative conclusion for reasons of their own. Regarding negative inclinations, there is a school of thought to the effect that the U.S. federal income tax should not be put to socioeconomic uses. Proponents of that view are generally responsible and well-meaning, and they are increasing in number as the U.S. federal income tax becomes more complex. However, their "tilt" may render them incapable of objective analysis of research credits, investment credits, accelerated cost recovery, and various other "tax preferences."

The research credit should be--and is--subject to oversight and continuous reevaluation in the light of shifting sentiments, including opinions about the efficacy of the existing income tax system and the multiple purposes to which it is put. Granting that the research incentive could be made more compelling at additional government expense, we nonetheless disagree with those few reviewers who have charged that the current version is either ineffectual and/or bizarre in its impacts.

A "Permanent" Credit

In reply to the Subcommittee's first inquiry, MAPI believes that the research tax credit should be made permanent so that taxpayers, who plan much of their research well into the future, can estimate the additional amount of financial resources they will have available to commit. With the "sunset" date rapidly approaching, many companies already engaged in their research planning for future years have had no choice but to assume--for want of better information--that there will be no credit after 1985.

"Sunset" and uncertainty.--Observers of the research credit have remarked that the incentive value of the device has been truncated by the moving, company-specific, base period. We would add that the incentive value of the research credit also is hurt by the automatic termination date because of uncertainties about extension. Sunset dates occasionally are used for the avowed purpose of ensuring that a policy, such as a tax incentive, will be reviewed rather than continue indefinitely without oversight. Little thought, however, is given to the dampening effect of the sunset date on the operation of the policy. Moreover, the sunset procedure is unnecessary because Congress can revisit a "permanent" item of legislation any time it wishes, and amend or repeal as the circumstances may seem to warrant.

To repeat, the termination date included in the research tax credit adds nothing but uncertainty. Over the years, we have had the same experience with what once was known as the on-again-off-again investment tax credit (ITC), another tax incentive that suffered in the past from congressional vacillation and occasional attempts at economic manipulation./1 We now have a "permanent" investment tax credit, and the research credit should be put on the same footing for the same reasons. Furthermore, this can be done by nothing more complicated than elimination of the termination date. Future Administrations and Congresses will not be prejudged by such action, and we are confident that the Subcommittee on Oversight will review the credit from time to time, whether prompted to do so by a sunset date or not.

Administration position.--Along those lines, it will be recalled that the Administration has taken the position that the research credit should be extended for three years and be modified in some respects. The purpose given for an extension, as compared to deletion of all references to a termination date, was to allow taxpayers some room for planning while at the same time retaining a termination date pending the outcome of an inquiry into the overall program of federal funding of research. We have no quarrel with the Administration's plan to review the government's program in support of research, but find the proposed, extended termination date rather than "permanency" to be unnecessary for--and, indeed, irrelevant to--the undertaking. In fact, the only sure thing about an extension is that it, too, will run out and, as its time expires, reduce or eliminate the incentive value of the credit itself.

1/ For one analysis of the debilitating effects of ITC manipulation by past Congresses and Administrations, see "The Investment Credit as an Economic Control Device," Capital Goods Review No. 67, MAPI, September 1966.

Stimulation

The Subcommittee asks whether the credit operates to stimulate additional research expenditures, or simply rewards increased research expenditures which would have been made in the absence of a credit.

Incentive at the margin.--The base-period design of the credit is intended to focus the incentive at the margin, that is, on the additional increment above a historical average. Consequently, one would expect the stimulus to apply to increased expenditures. Whether the additional dollars of research expenditure actually entail additional research depends on whether the purchasing power of the dollar as it applies to research has changed between the current year and the base years. As the Subcommittee is aware, the base period is not indexed for inflation, a "refinement" that was considered but rejected because of its complexity and equity considerations. We understand the position of "purists" who might prefer to have the incentive apply only to real increases, but we also agree with the original judgment.

Reading minds.--Having stated that the credit works at the margin, we conclude that it stimulates additional research expenditures in situations where the credit translates into cash flow not otherwise available for the incremental research activity. Whether the credit simply rewards increased research expenditures which would have been made in the absence of a credit is not susceptible to a flat "yes" or "no" response. Some persons will accelerate research activity solely because a potential market appears where one previously did not exist. To the extent that the decision on research is completely market-driven, the credit rewards incremental activity that would have occurred anyway. The tax law cannot be written to read minds, and the implication that a credit could be fashioned to apply only to research not otherwise intended is a bit simplistic.

Even where the credit applies to research that would have been conducted in any event, the credit applies only to the increment over the base-period average and, depending on the taxpayer's circumstances, provides additional financing to justify projects that entail greater risk.

Types of Research

Regarding the types of research expenditures and industry activities that have generated use of the tax credit, it is fair to say that all types of R&E encompassed by the existing definition in Code Section 174 have been included.

Redefining R&E.--As to the definition of "research and experimentation" in Code Section 174, experience of the Internal Revenue Service to date suggests that some restatement may be in order. "Research and experimentation" is a challenging phrase to define, and the existence of the research credit places a premium on clarity if the purposes of the credit are to be achieved. When the tax-writing committees again address the subject, we recommend that attention be given both to the definition used by the National Science Foundation and to the one contained in Financial Accounting Standards Board (FASB) Statement No. 2. These are logical starting points because they already are in use for other purposes and articulate the concept as it is understood by many. Perhaps the more authoritative and more widely recognized view is the latter, as adopted for financial accounting. For additional thinking on the definition in the tax context, reference may be had to House Report No. 97-201 of July 24, 1981/1 and Senate Print No. 98-169, Volume 1, of April 2, 1984./2

Misclassification.--We suspect that Code Section 44F should have its own definition of "research and experimentation," to perfect the purposes of Congress in enacting the credit and to narrow the field of dispute between government and taxpayers. However, we disagree with some observers who contend that the existing definition admits of rampant misclassification. There will be some noncompliance--deliberate or inadvertent--with any research tax credit, and credible estimates we have seen of noncompliance under the existing arrangement hardly are a cause for alarm.

Broadening or Narrowing the Categories

The Subcommittee asks whether the categories of qualifying research expenditures should be broadened or narrowed. In our opinion, they can be "tightened up" without substantial change in either direction. By sharpening the definition of "research and experimentation" at its interface with other expenditures that arguably would fit the classification as it now stands, Congress necessarily would narrow somewhat the applicability of the credit currently claimed. While we can tolerate some narrowing for the purpose of "clarification,"

1/ This was the report of the House Committee on Ways and Means concerning the proposed "Tax Incentive Act of 1981," wherein the research credit (Section 241 of the bill) was covered on pages 109 through 126. The research tax credit eventually enacted as part of the Economic Recovery Tax Act of 1981 was developed in the Senate and differs from the proposal discussed in House Report No. 97-201. However, the Report is instructive with respect to the redefinition of "research and experimentation" then under consideration.

2/ This "Print" actually serves as the Senate Finance Committee report on the Deficit Reduction Act of 1984. A discussion of proposed amendments to the research tax credit can be found on pages 899 through 912, a portion of which deals with the matter of redefining "research and experimentation" specifically for application to Code Section 44F. Although the research tax credit provisions were eliminated by Joint Conferees from the final enactment, the exposition in Senate Print 98-169 also may be instructive.

we also believe that additional guidance should generally be consistent with existing regulations--as intended by Congress in enacting the credit/1--and generally accepted concepts of "research and experimentation."

The IRS proposal.--As the Subcommittee may know, IRS issued proposed regulations in the Federal Register of January 21, 1983, aimed at implementing the research tax credit. At the time, "research and experimental expenditures" was said generally to mean expenditures incurred in connection with the taxpayer's trade or business which represent research and development costs in the experimental or laboratory sense. The proposal went on to state that the phrase includes, generally, all such costs incident to the development or improvement of an experimental or pilot model, a plant process, a product, a formula, an invention, or a similar property. Also, the phrase was said to include research aimed at the discovery of new knowledge and research searching for new applications of either research findings or other knowledge. IRS went on to exclude eleven types of activity, and to provide five examples to illustrate the application of the proposed principles.

Software, IRAD, etc.--While MAPI approved of the general principle stated in the proposed regulation and just mentioned (above), we faulted a number of the exclusions and examples for failure to take into consideration situations--unanticipated by IRS--in which "research and experimentation" by anyone's definition often occurs. Also, we disagreed with the separate treatment given to the costs of developing computer software, as well as the unrealistically severe position taken with respect to that activity. We also disagreed strongly with the notion of IRS that "independent research and development" (IRAD) allocated to cost-plus and incentive-type contracts with the government should be treated as "funded" by another person, and hence disqualified. Reasons and recommendations were provided in each instance.

Inasmuch as the Subcommittee is concerned with oversight, we will reserve our more specific views about the definition of "research and experimentation" until a later date before the cognizant forum.

Taxpayers and IRS

The Subcommittee would like to know whether taxpayers and IRS have been able to distinguish, accurately, qualifying expenditures from non-qualifying ones.

Reasonable interpretation.--We acknowledge that there are "grey areas" at the interface such that reasonable minds might differ on the classification of some items. This is partly a matter of definition and partly a matter of enforcement, as already explained. Making this

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1/ See Senate Report 97-144, July 6, 1981, p. 81.

distinction has not been particularly "difficult" for taxpayers because the vast majority have sought to identify "research and experimentation" expenditures consistent with reasonable interpretations of the instructions already provided. We cannot speak for IRS, but note that Treasury testimony/1 has reflected some IRS concern about credits claimed for expenditures that are not "research" in anyone's lexicon. As indicated earlier, there will be some noncompliance irrespective of amendments to the research credit.

Ambiguity and peril.--In that connection, and seemingly in reinforcement of our view that misclassification is not widespread, Treasury sometimes has taken the position that ambiguities can go undefined in the tax law for a period of time without risk to the revenues because the uncertainty caused by the ambiguity tends to restrain taxpayers. In other words, ignorance of the law is no excuse, and persons who would take liberties with the "research and experimentation" definition do so at their peril. If this thesis is correct, the Subcommittee can rest assured that it is not dealing with a noncompliance "runaway."

Base Period Computation

The Subcommittee wishes to know whether the base period computation rules are appropriate and have a positive impact on increasing R&E expenditures.

Recap.--We have responded earlier by noting that the emphasis is at the margin; that indexation was omitted for reasons of administrative simplicity; and that Congress could "hype" the incentive effect, but not without additional complication and/or revenue cost. Also, we have acknowledged that a taxpayer's lack of income tax liability defeats the incentive in some instances, but that credit refundability would be expensive and, perhaps, controversial on "industrial policy" grounds. Finally, we have asserted that it is an exercise in metaphysics to speculate on whether a credit simply rewards expenditures that would have been made anyway.

Eliminate the base period?--In this context, we will add that neither the investment tax credit nor the new Foreign Sales Corporation export incentive have base periods. Without a base period for a tax incentive, a taxpayer generally has additional cash flow from engaging in the favored activity whether it constitutes an incremental expenditure or not. If Congress were to assign a still higher priority to research and experimentation, tax policy makers might consider

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1/ See comments of former Treasury Assistant Secretary (Tax Policy) John Chapoton before the Senate Finance Subcommittee on Taxation and Debt Management, May 27, 1983.

eliminating the base period so that all qualifying activity would be aided. It stands to reason that, with additional cash flow from a tax credit, a taxpayer is more likely to undertake a risky endeavor--whether incremental or not--than if the extra resource is not there. Further, the taxpayer is better able to predict the existence and amount of the added resource if there is no base period.

Credit and Deduction

The Subcommittee asks whether both a credit and tax deduction should be available for the same research expenditures. Of course, the answer to the question is a function of the national priority placed on R&E work conducted in the private sector. The 1981 decision to have tax credits in addition to current deductions was deliberate and reflected the considerable degree of importance ascribed to innovative activity. A review of the existing tax practices in a number of other countries would quickly establish that the United States is not alone in providing impetus of this magnitude to favored spending.

A curious dichotomy.--We find a curious dichotomy reflected in certain of the Subcommittee's questions. On the one hand, the Subcommittee seems concerned that a credit and current deduction may be too generous. On the other hand, the Subcommittee wonders whether the credit operates at all as intended, or is in fact another bootless experiment, as alleged by certain researchers. Obviously, existing policy cannot be all things to all people, as some would have it be. However, as explained earlier, the credit operates in a manner consistent with its design; offers no surprises to persons who understand how it operates; and gives a narrowly targeted benefit to those who qualify.

Revenues

The Subcommittee next asks about the impact of the tax credit on federal revenues.

A matter of opinion.--As already discussed, one researcher has indicated that the revenue loss was approximately $1 billion in 1983. We do not know the assumptions that surround that estimate of cost, so we can neither substantiate nor dispute it. It is, however, a very safe bet that a reputable consultant could be found who would hold the loss to be more or less, depending upon his own views with respect to numerous variables having a bearing on the amount. On a related point, the Subcommittee will recognize that revenue loss often is discussed only in terms of the cost side of the equation, to the exclusion of benefits that may be either tangible or intangible but in no case should be overlooked.

To extend this line of thought, one research-intensive venture for which expenditures (i.e., outlays only) might readily be measured would be the U.S. government's program that resulted in a moon landing in the 1960s. Even if agreement could be reached on the amount of the outlays, opinions would differ markedly as to the net cost of the program, comprehending both costs and benefits (including technology-transfer).

No cause for alarm.--As noted, we have yet to see anyone's estimate of the revenue cost of the research credit that causes us alarm. Moreover, the modifications to the credit that were recently under consideration by House-Senate conferees might well have reduced the estimates by narrowing the scope of qualifying expenditures. In so stating, we refer only to the anticipated costs of a proposed indefinite extension of the credit and the proposed new definition of "research and experimentation." We have no comment on other initiatives that were intended to spur innovation through further changes to the credit or to charitable contributions deduction policy, because they are beyond the scope of the Subcommittee's investigation.

Industry Spending

The Subcommittee asks about the impact of the research credit on industry spending and allocation of R&E budgets.

Positive impact.--In our opinion, the impact is positive for companies that have qualifying expenditures and can make use of the credit. It also is possible that the credit has some bearing on allocations as well as total budgetary allotments, but we have no evidence of the same and have no reason to think that an incentive equally available for different kinds of eligible spending would somehow favor certain types over others. We reject as nonsensical the assertion of some researchers that companies with gyrating base period experiences will sometimes feel a need to reduce qualifying expenditures in certain years in order to "adjust" the average base period experience to ensure benefits in the following year.

Ask the right persons.--As reported earlier, the National Science Foundation interviewed executives concerning the reasons for increased research activity in 1983, and was informed that part of the cause was the research credit. We repeat that it is important, in determining whether the credit has the desired incentive effect, to ask the right individuals, namely, those who decide both the projects to be undertaken and the funding (including sources thereof) to be committed. With the exception of companies that cannot use tax credits due to net operating losses, a high base period, recession-induced cutbacks in current R&E spending, or other reasons, we are told that the credit operates as an inducement to increased research spending.

Congressional Intent

The Subcommittee asks whether present-law rules on the availability of the credit have been effective to accomplish congressional intent.

We already have responded to this, and, accordingly, will not belabor the point. If the Subcommittee emerges from its hearings with any doubts about the effectiveness of the credit, we suggest that they be resolved in terms of liberalizing the mechanism rather than repealing it. We will have specific recommendations to offer to a legislative committee at a later date.

Statutory or Administrative Changes

The Subcommittee concludes by inquiring whether, in the event the credit is continued, any statutory or administrative changes should be made.

Our first priority is permanency for the credit so that its incentive effect will not continue to be watered down by doubts concerning credit availability in future years. We acknowledge further that the definition of "research and experimentation" needs some attention, which might best begin with the concept of "research and development" embodied in generally accepted accounting principles articulated by FASB Statement No. 2.

Concluding Comment

We think it unfortunate that House conferees stood in the way of amendments to the research credit that might have been included in the Deficit Reduction Act of 1984. The credit has not gone without congressional oversight, and considerable attention already has been given to reworking the definition of R&D to facilitate compliance and administration. Delay is counter-productive under the circumstances, and research should be given the high national priority that it deserves. Further, the tax credit is a preferred mechanism for providing an incentive to innovative activity, because the credit is virtually self-executing, requires no special bureaucracy to administer it, and entails minimum distortion to the marketplace and private decision-making.

On a concluding note, we trust that the Subcommittee will keep in perspective the findings of any purportedly disinterested observers who charge that the credit is either useless or bizarre. Unlike persons who seemingly lack background in the subject, we find the tax incentive to be performing approximately as intended and without unanticipated effects. Currently, the credit reflects congressional determinations of 1981 about the importance of research at that time; revenue limitations; credits versus direct subsidies; favored activities; applying an incentive at the margin; and a host of other factors. The next Congress to deal with these questions may well arrive at different conclusions, but not because the original judgments were ill-considered or fortuitous. MAPI has previously supported, and will continue to advocate, a substantial research incentive of this kind.

We hope that these thoughts will be of some use to the Subcommittee on Oversight.

STATEMENT OF SENATOR CHET ATKINS, COMMONWEALTH OF MASSACHUSETTS

My name is Chet Atkins. I am a senator in the Commonwealth of Massachusetts. I appreciate the opportunity today to present testimony on behalf of HR 4475, the High Technology and Scientific Education Act of 1983.

I come from a state whose recent economic history is quite different from most other states. Unlike much of the country, Massachusetts has enjoyed a relatively low unemployment rate and has seen sizeable growth in its personal income in recent years. These factors are largely the result of the success of the state's numerous high technology companies. While our high technology firms are diversified, and I hesitate to join them together under any single mantle, they do share one common trait--their success is dependent upon the development of new products and technologies. There is only one way to develop new products and technologies and that is through research and development actions.

Research and development activities are necessary for progress; however they do not always provide immediate paybacks, nor are they inexpensive. Industry needs to develop new materials, processes, and products to reduce manufacturing costs, energy consumption, and natural resource depletion, and to improve productivity. At the same time, the cost of equipment, machinery, and personnel required for sophisticated research and development facilities is prohibitive. HR 4475 would make permanent the provision adopted in 1981 to allow an additional exemption for certain research and development expenditures. That provision has served as an additional stimulus to the companies in my home state to undertake expanded research and development programs. As a parallel program to the federal law, Massachusetts inserted provisions in its corporate tax and sales tax laws to encourage research and development expenditures. These provisions allow extra deductions for such expenditures and exemption from the state sales and use taxes for scientific and research property donated to the state's institutions of higher learning. These laws have proved to be a great success, and the list of resulting breakthroughs by Massachusetts' companies and universities is extensive.

An increased level of research and development is a challenge the United States must face in order to compete with Japan and other technology based companies around the world.

HR 4475 provides a response to that great challenge by encouraging research and development and providing assurances that the nation's technology based economy will prosper in the 1990's and beyond.

STATEMENT OF THE MASSACHUSETTS TECHNOLOGY PARK CORP.

The Massachusetts Technology Park Corporation respectfully presents a written statement in support of an amendment to the Internal Revenue Code calculated to ensure that our Nation's colleges and universities have the opportunity to benefit from comprehensive, negotiated partnerships between State government and business and industry in complex and emerging areas of science and technology education.

The importance of technology based higher education to the economic development of the United States is not subject to question. It is a matter of historical record that the growth and development of some of our most important industries, including textiles, agriculture, aerospace, medical science and electronics, but to name a few, have depended upon the capabilities and resources of our institutions of higher education. And it is reasonable to propose, without concern for overstatement, that the futures of our Nation's mature industries and high technology service section alike are inextricably related to the ability of our colleges and universities to off sophisticated academic and research opportunities in areas such as microelectronics, advanced materials sciences, robotics and automated devices.

Yet, notwithstanding the importance of technology based higher education to this Nation's economic future, our institutions of higher education are increasingly frustrated in their attempts to engage in basic research and research training activities in critical, emerging areas of science and technology education. Although the reasons for such frustration are many and include a shortage of qualified faculty and an inability to arrange for effective technology transfers from the business to the academic spheres, the most egregious obstacle to full university participation in the advance of technology is the lack of access to the sophisticated scientific equipment and machinery required therefor. The capital costs associated with such scientific equipment are substantial and the capital costs required to maintain educational facilities at a level consistent with development technology have become prohibitive.

It was in due recognition of the foregoing that the Congress enacted Internal Revenue Code Section 170(e)(4) in the Economic Recovery Tax Act of 1981 creating a substantial tax incentive for "qualified research contributions" to colleges and universities. A manufacturer of scientific equipment is entitled to donate state-of-the-art inventory property to an institution of higher education if such equipment is subsequently employed by the donee in basic research or research training activities in the physical or biological sciences. This farsighted provision of the tax code has enabled many universities to secure scientific equipment which would have been otherwise beyond their means, to the immediate benefit of the students and faculty and to the ultimate benefit of our economic future.

The Senate version of the Deficit Reduction Tax Bill of 1984 contained an explicit achnowledgement of the importance of this tax incentive for contributions of scientific equipment: Section 883 thereof would have continued the current law and expanded the types of property for which such an incentive is available to include computer software and used equipment. The Corporation wholeheartedly supported the efforts of the United States Congress in this regard. Unfortunately, Section 883 failed to survive the review of the House-Senate Conference Committee earlier this summer.

The amendment which the Corporation is today proposing was a relatively minor portion of said Section 883 of the Deficit Reduction Tax Bill. It would have expanded the class of donees elegible to receive "qualified research contributions" to include a wholly owned instrumentality of a State which creates and operates sophisticated educational facilities which are accessed on a shared-use basis by a number of colleges and universities simultaneously.

It has become apparent that in certain emerging areas of science and technology education it is beyond the capacity of a single institution of higher education, even with an eligibility to receive "qualified research contributions" to support the creation and operation of the expensive facilities required for sophisticated academic and research opportunities. Indeed, it is the reasoned determination of many concerned with the development of technology based higher education that, just as the required scientific facilities are often beyond the capacity of a single college or university, so too are such facilities beyond even the collective capacity of a consortium of institutions of higher education. What is required, in certain cases, is a new and innovative administrative vehicle: a public instrumentality which creates comprehensive, negotiated partnerships between State government and business and industry for the benefit of a number of institutions of higher education.

In Massachusetts, the Legislature has created just such an innovative administrative vehicle. The Massachusetts Technology Park Corporation is a public instrumentality established to further economic development by developing negotiated partnership agreements between the State and business and industry which serve to increase the capacities of Massachusetts colleges and universities to offer academic programs and research opportunities in certain emerging areas of science and technology. As provided by the Massachusetts Technology Park Corporation's Enabling Act, a negotiated partnership is to take the form of a State owned physical facility known as an "educational center". Each educational center shall be created and operated jointly with State provided support and contributions of scientific equipment and machinery from business and industry and is to be accessed on a shared-use basis by the public and private colleges and universities of Massachusetts.

Universities currently participating in the Massachusetts Technology Park Corporation and represented on its Board of Directors include: Boston University, Massachusetts institute of Technology, Merrimack College, Northeastern University, Southeastern Massachusetts University, Tufts University, the University of Lowell, the University of Massachusetts and Worchester Polytechnic Institute. Businesses which are similarly participating and represented are: Alpha Industries, Analog Devices, Data General Corporation, Digital Equipment Corporation, GCA Corporation, Polaroid Corporation, Prime Computer, Inc., Raytheon Corporation, Unitrode Corporation and Wang Laboratories.

The first educational center of the Massachusetts Technology Park Corporation shall be a facility concerned with semiconductor and microelectronic technologies, to be known as the Massachusetts Microelectronics Center. The Commonwealth of Massachusetts has appropriated the sum of twenty million dollars ($20,000,000) as its share of the cost of creating this Center. Certainly, this exciting and attractive approach to a collective effort in support of technology based higher education stands deserving of the amendment proposed here today.

Absent the enactment of the proposed amendment to the donee provisions of Section 170(e)(4)(B)(i) of the Internal Revenue Code, there is a substantial question as to whether the Corporation would qualify as a proper donee. Such an adverse result would frustrate the interests of the colleges and universities of the Commonwealth and, ultimately, threaten the entire Massachusetts economy.

Accordingly, the Corporation respectfully requests adoption of an amendment to Internal Revenue Code Section 170(e)(4)(B)(i) which expands the class of eligible donees for qualifed research contributions to include public instrumentalities which create comprehensive negotiated partnerships among State government, business and industry and institutions of higher education.

MEDTRONIC, INC.,
Minneapolis, MN, August 17, 1984.

Hon. CHARLES B. RANGEL,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, U.S. House of Representatives, Washington, DC.

DEAR SIR: Medtronic strongly supports a permanent extension of the research tax credit presently provided by the U.S. Internal Revenue Code.

Medtronic is the world's largest producer of implantable medical devices and other biomedical engineering products. Over the past 10 years, we have invested approximately 8.5 percent of each sales dollar in research and development. During our past three fiscal years, (since the inception of the credit allowed under Section 44F, Internal Revenue Code, for increasing research expenditures), our spending has increased 46 percent. The major part of our current business is the manufacture and sale of implantable cardiac pacemakers, but we are committed, as a matter of corporate policy, to diversification within the health care field.

We feel that the type of research and experimentation that we perform actually reduces health care costs on a long term basis, and therefore will ultimately save federal medical payment agencies bottom line dollars.

The attached comments are respectfully submitted for your consideration in addressing the specific issues you have outlined previously.

Sincerely yours,

MICHAEL J. BORIS,
Treasurer.

Attachment.

Does the credit operate to stimulate additional research expenditures, or simply reward increased research expenditures which would have been made in the absence of the credit?

For Medtronic, the answer is yes to both parts of this question. Our company is, and has been, strongly committed to significant investments in research and development, and would undoubtedly continue to be even in the absence of an income tax credit.

However, the credit has had an impact on spending. During our fiscal year ended in April 1984, research spending had increased to 147 percent of the total spent in the year ended in April 1981. Selling, general and administrative costs for 1984 were 126 percent of the same base year. In the year ended in 1981, Research expenditures were 7.9 percent of sales revenue, and this increased to 8.9 percent by the end of April 1984. (Sales revenue increased by 31 percent over this same period.)

Also significant, in terms of the credit, is the geographic location of spending. Over this period of time, research spending outside the United States (which does not qualify for the tax credit) actually declined, both as a percentage of the total and in actual dollars, while U.S. expenditures increased. Had the credit not been available, more research activity would have taken place outside the U.S.

What types of research expenditures and activities have generated the credit?

We have devoted increasing attention to basic research which has potential health care applications, although the bulk of our activity remains in applied research. Improvements in product quality, reliability and features all lead to improved cost effectiveness in the delivery of health care over a period of time.

A significant portion of expenditures ($2.2 million in the year ending April 1981, $4.3 million in 1983 and $4.9 million in 1984) are attributable to an implantable drug administration device which allows more effective administration of medication than has been available in the past.

There has been an increasing investment in tachyarrhythmia (too rapid heartbeat) control work. This affects a significant portion of our population which is not presently treated effectively by medication.

We have invested in instrumentation and diagnostic equipment research which contemplates the ability to reduce overall health costs by providing more efficient and effective diagnostic tools to health practitioners.

Expenditures continue to be made in our mainline cardiac pacing business to expand and improve both quality and cost effectiveness of the products.

Should the categories of qualifying research expenditures by broadened or narrowed?

In general, we feel that the existing categories are appropriate. An additional type of expenditure/cost should be included, however.

Depreciation expense on equipment used in research activities should be a qualifying expense. This would remove the credit from the normal operation evaluation of whether to lease or purchase equipment, since rental expense for such equipment is treated as a qualifying cost.

Are the base period computation rules appropriate and do they have a positive impact on increasing research and experimental expenditures?

We feel that the rules are appropriate and further do have a positive impact. As structured, with no penalty (beyond a decrease in credit for a particular year) for a reduction in expenditures, they may present an opportunity to accelerate spending in one year at the expense of a future year in order to maximize the credit, but this is not likely to be consistent with good operating judgments. The fact of the sunset provision seems likely to encourage consideration of this tactic more than the existence of the credit. The 50 percent limitation is something of a deterrant to an acceleration approach of this nature.

Should both a credit and a tax deduction be available for the same research expenditures?

Medtronic feels that the credit, as presently structured, does provide significant incentives for increasng research expenditures. It provides a benefit for undertaking projects which by their nature entail substantial risk of failure, and which, even when successful, may not produce income until some future period. If the benefit is reduced, the incentive is also reduced.

Should the credit provisions be allowed to sunset, be extended, or be made permanent? If the credit is continued, should any administrative changes be made?

The credit should be made a permanent part of tax law.

A permanent credit encourages incremental investment in research, but in a more orderly and efficient manner than may be the case with an obviously temporary credit.

Some taxpayers hav undoubtedly not availed themselves of the credit because the administrative cost may have outweighed the potential tax benefits. Medtronic, which has historically had significant research spending, and has, for operating reasons tracked the costs, never-the-less had to develop a new information system in order to accumulate required data for the credit had a degree of permanence would, in our opinion, cause them to direct more attention to increasing research activities, and be willing to invest resources in data accumulation.

It is important to note that various of our international trading partners offer significant incentives for local research activity. Canada has a device very similar in effect to that of the U.S. Internal Revenue Code, France has introduced a tax credit based on incremental spending, and a number of countries provide direct tax-free grants to support this activity. Withdrawal of the incentive in the United States would increase the financial appeal of performing research outside the United States.

STATEMENT OF ADM. B.R. INMAN (USN, RET.) CHAIRMAN, PRESIDENT AND CHIEF EXECUTIVE OFFICER, MICROELECTRONICS & COMPUTER TECHNOLOGY CORP.

I appreciate the opportunity to express my support for the creation of a permanent, non-incremental tax credit for industrial contributions to university research and development programs.

As you may know, MCC is a joint venture of 18 American companies. Our objective is to conduct long range research designed to significantly advance the state of the art in microelectronics and computer technology. We anticipate that, during the course of our mission, we will establish important relationships with universities and we, therefore, have a strong interest in this issue. In addition, the corporate shareholders of MCC have been significant supporters of academic research and development.

My support for this measure is consistent with my belief that the technological competitiveness of the United States is inexorably linked to the successful implementation of several important public policy actions: (1) the encouragement of joint research and development ventures; (2) continued and increased federal funding for key basic technological research; (3) establishment of a permanent tax credit for industrial research; and (4) the establishment of the proposed non-incremental tax credit for industrial contributions to university research.

The necessity of these actions have grown in the face of aggressive and well funded efforts in several foreign countries, most notably Japan, Great Britian, West Germany and the common market nations. Several statistics indicate the result of increased success in foreign research activities. The National Science Foundation points out that from 1972 to 1981, domestic patenting by U.S. inventors declined 24 percent, and in 1983, foreign originated patents accounted for 40 percent of all patents filed in the U.S., compared with just over 20 percent in 1981. According to the International Trade Administration, U.S. market share of technology intensive products also fell from 23.1 percent in 1970 to 19.9 percent in 1980.

The United States worked hard to obtain its position as the preminent provider of technology. In the early days of this Republic we were consumers of technology. Innovation was centered in Western Europe and the revenues and royalties for those innovations flowed from our country back to Western Europe.

Then in the darkest days of the Republic, in 1862, the Congress in its wisdom enacted the Morrill Act, creating the land grant colleges and laying the foundation for the creation of technology in this country on a very broad scale. MIT did a study not long ago on the economic growth of this country from 1860 to 1940. It was their judgment that 80 percent of the growth in the gross national product was a result of creating technology and commercializing it.

Then after 1940, the demands of World War II brought something new to these shores: a collaboration between the academic community, private industry, and the government on a scale that we had never before witnessed. Driven by the crisis, that trilateral collaboration produced the weapons that won the war and laid the basis for a great leap forward in our economic capability. For example, out of the search for substitutes to replace scarce resources came synthetic fibers.

In the years immediately after the war came the greatest single investment in education that has occurred anywhere on this globe: the G.I. Bill and the often forgotten but very substantial unconstrained grants from the Federal government for graduate studies in science and engineering. From that surge came a capacity to create technology unequaled anywhere on the globe and a reasonable process of commercializing that technology at an advantageous pace. Indeed, if you look around at many of the best universities and best companies in this country, you will find people in key leadership positions who earned their baccalaureate degree on the G.I. bill and their doctorate on a grant from the Office of Naval Research or one of its counterparts.

But then came the 1960's, when we lost our way on so many things. In 1963, we were moving far along in applying a new measuring rod to national security: Is it cost effective? Some things can be measured reasonably for cost effectiveness, but many other elements of government and infrastrucutre don't stand up well. For example, the intelligence community found that it was hard to justify investment in such "esoteric" and seemingly irrelevant data as fundamentalist Islamic religious.

In the field of education and for the ability to create technology, the impact soon came. It was decided that it was not cost effective for the Department of Defense to make unconstrained grants for doctoral studies in Science and Engineering. Such grants could only be made if the study could tie directly to a future weapons system.

You can then chart, beginning in 1968, the decline in the number of U.S. graduate students in science and engineering. The seats didn't go vacant in the graduate schools of this country, however. Foreign students came in large numbers, usually on full scholarships from their government. We have, over the last 15 years, greatly broadened the technology base of much of the rest of the free world. Granted, some of those who came have stayed on with green cards or citizenships and are productively engaged in our university and industry laboratories. But many have gone home to pool their talents and use innovative approaches to create techology in the refurbished post war economics of their native countries.

Now, in the face of an increasingly competitive international marketplace, we must reawaken the trilateral collaboration that pushed us into the forefront of technological preeminence. We have seen early signs of this reawakening, as universitites and industries increasingly cooperate and government, at the state and Federal levels, increasingly seeks ways to encourage economic development and technological advancement.

However, too often our colleges and universities, who provide the majority of critical "basic research, find themselves hampered by inadequate funding or equipment. For example, the National Science Foundation discovered that university reseachers classify about one fourth of the 22,300 items in their 1982 research equipment inventories as obsolete and no longer in research use. NSF also discovered that of all research equipment listed in 1982 inventories, only 16% was characterized as state of the art and more than 90% of the departmental chairpersons in the surveyed disciplines reported that the lack of equipment inhibited the conduct of critical research.

In recent years, industry has increased its support of academic research, while at the same time government support has continued to decline. According to the National Science Foundation, after inflation was taken into account, the federally financed portion of basic research spending decreased more than 2 percent between 1981 and 1982 while support from federal agencies for applied research and development declined over 3 percent. Support from industry, according to NSF, although providing less than 5 percent of total academic R&D funding, jumped 13 percent in 1982 (6 percent in real dollars) to $326 million, continuing to show the most rapid growth rate among the major sources of R&D support.

Recently, several key efforts have received much national attention. The creation of the Center for Integrated Systems at Stanford, the Semiconductor Research Corporation in Research Triangle, North Carolina, and our own Microelectronics and Computer Technology Corporation, are examples of industrially supported research activities incorporating strong collaboration with universities.

Economic analysts estimate that, by itself, the establishment of a nonincremental permanent R&D tax credit for industrial contributions to academic research and development will cost $130 million annually, and could generate substantial additional dollars in corporate support of university R&D. There is little argument among economic observers that such investments in research and development provide substantial returns on investment, both directly and indirectly, a fact recognized by the Ways and Means Committee when it passed the tax credit provisions in 1981.

Further, establishing the credits as a permanent fixture rather than on the temporary basis which currently exist will allow universities and then industrial partners to better plan R&D strategies. But I must reiterate, that whether the cost benefit analysis yields a positive, negative, or neutral result, such efforts should not be evaluated in a vacuum, and must instead be considered within the context of a larger set of policy objectives and tools. Tax credits for industrial and university R&D are both important parts of a national policy which encourages crucial research and development, ultimately contributing to our national productivity and economic growth.

Now is not the time to dissasemble this set of tools and to step back from the initiatives that have promoted positive actions in recent years. For these reasons, I offer my support for the industry/university tax credit program.

OTTO ENGINEERING, INC.,
Carpentersville, IL, July 23, 1984.

JOHN J. SALMON,
Chief Counsel, Committee on Ways and Means,
Longworth House Office Building, Washington, DC.

GENTLEMEN: We are a privately owned manufacturing company with 135 employees and sales of $6 million. Our products are proprietary and we frequently design new ones or adaptations for our customers.

We were encouraged by the Research Investment Tax Credit to undertake a considerable expansion of our technical facilities. This involved commitments for new products such as our computer driven adhesive applicating robot, hiring of technical people, including draftsmen (women), laboratory personnel, engineers, and finally the decision to install C.I.M.

Computer Integrated Manufacturing includes CAD/CAM which starts with computer aided design. We are installing complex computer equipment and training technical employees in its use. We have become a demonstration site.

All of this is a considerable commitment for a company of our size. Normally, we have been conservative in the use of bank credit, preferring to grow at our steady 20% rate from our own cash flow. We would not have made these expensive decisions if not for the tax encouragement.

If you wish to know if the incentive is there is the tax law, I'll tell you it is.

If you change this incentive at this late date in a way to effect our funding, you will have broken faith and harmed a previously stable company grievously. Our commitments extend through 1988.

This is our experience. Please take it into consideration.

Very truly yours,

J.O. ROESER,
President.

PHARMACEUTICAL MANUFACTURERS ASSOCIATION,
Washington, DC, August 10, 1984.

Hon. CHARLES B. RANGEL,
Chairman, Subcommittee on Oversight, Committee on Ways and Means, House of Representatives, Longworth House Office Building, Washington, DC.

DEAR MR. CHAIRMAN: On behalf of the Pharmaceutical Manufacturers Association, I am pleased to present the views of the Association on the Federal income tax credit for incremental research expenditures. PMA believe that the R&E credit enacted as part of the Economic Recovery Tax Act of 1981, which will expire at the end of 1985, should be made a permanent rule of United States tax law as an important incentive for the expansion of domestic research.

PMA is a nonprofit scientific and professional organization representing firms that discover, develop and produce most of the prescription drugs used in the United States, about half the free world's supply of drugs, and a large part of the world's medical devices and diagnostic products. Major research projects are long-term efforts requiring significant periods of lead time. The enormous costs of research in the pharmaceutical industry, with absolutely no guarantee of the availability of the credit beyond a cut-off date decrease the likelihood that the highest risk projects will be undertaken. Making the credit a permanent incentive similar to the investment tax credit would give the pharmaceutical industry, as well as other research intensive industries, the assurance that the credit will be available for expenditures made during later stages of projects currently under consideration.

The amount of research activity undertaken in any industry is the result of a number of factors, including competition for the employment of company resources. The research credit provides an additional resource that is directly related to the amount of research that is undertaken. Significantly, the credit provides an immediate favorable earnings impact for an investment decision that itself has a long term objective. This ia a very practical consideration for corporate planning. The precise amount of additional research due to the credit will always leave some area of uncertainty. What is certain, however, is that termination of the research credit will reduce the resource available for additional research by pharmaceutical and other research based companies that bear comparatively high effective tax rates.

In an international environment is which governments have adopted programs to further the technological competitiveness of their industries, extension of the research credit on a permanent basis will enhance the competitive position of U.S. companies.

Sincerely,

Lewis A. Engman,
President.

Public Health Research Institute of the City of New York, Inc.,
New York, NY, September 7, 1984.

Hon. **Charles Rangel,**
Chairman, Subcommittee on Oversight, Committee on Ways and Means, Rayburn House Office Building, Washington, DC.

Dear Mr. Rangel: The Public Health Research Institute is a free-standing biomedical research facility in New York City. It has the highest reputation in the research community, is known for its productivity, and has been exceptionally successfully in obtaining research grant support. However, as the federal expenditure for biomedical research has fallen (in constant dollars) and the competition for those dollars has increased, research institutes, like the Public Health Research Institute as well as other non-profit research organizations including universities, have had to reach further for support for their activities. As you know, current law (Economic Recovery Tax Act of 1981) provides an R and D tax credit for corporate grants for basic research activities, but only if they are made to academic institutions of higher education. Although non-profit research institutes do the same kind of research as universities, they are excluded from this tax credit incentive for corporate support. Certainly the advantages of stimulating support for basic research by industry has been explicitly recognized by Congress, and the exigencies of the funding scene will make such connections increasingly important from non-profit organizations. Therefore, it is most important to seek ways to enhance the interest of the industrial sector in the support of basic research wherever its quality is highest.

In this light, the occasion of considering the High Technology Research and Scientific Education Act, H.R. 4475 and S. 2165, provides an ideal opportunity for Congress to examine the importance of extending this tax credit benefit to corporations supporting research at all non-profit organizations, not only at universities. Renewal of the R and D tax credit provisions is a very valuable step, and we would urge your support for provisions extending this tax credit to support of research at all non-profit research organizations.

As the excess publicity dies away from biotechnology and the economic importance of research in this arena increases, the Committee on Ways and Means may be asked to consider more legislation concerning research and applications in this new area. Perhaps it would be useful for you to visit the Public Health Research Institute and allow us to give you a first hand view of the excitement and promise of our current work in biotechnology. We, of course, would be delighted to show you the Institute. If a visit is of interest to you, I would be pleased to make arrangements at your convenience.

Sincerely yours,

David P. Beck, Ph.D.,
Associate Director for Administration.

Richardson-Vicks, Inc.,
Wilton, CT, July 25, 1984.

Mr. **John J. Salmon,**
Chief Counsel, Committee on Ways and Means, U.S. House of Representatives, Longworth House Office Building, Washington, DC.

Dear Sir: Please consider this our written statement in support of the permanent continuation of the 25% research and experimental tax credit. This statement is in lieu of a personal appearance at hearings scheduled on July 31 and August 1, 1984 to examine this credit which is scheduled to expire on December 31, 1985.

In 1979 the Joint Economic Committee warned that the declining rate of productivity would probably mean a lower standard of living for America in the 1980's. Spurred on by this and other reports of America's declining rate of productivity, Congress passed the R&E credit in 1981. The purpose of this credit was to encourage research which in turn would result in improved productivity.

We believe this credit has over the last few years helped the country maintain its technological superiority and compete effectively with its foreign competitors. In many instances, the availability of the credit has been the difference whether or not a research project has been undertaken.

The credit can become even more effective if it is made permanent. This is because many research projects extend over a number of years and these projects represent a substantial long term commitment on how a company allocates its funds. A permanent credit would be a meaningful part of this allocation decision process because then these long term projects could be started with the assurance that the credit will be available when the funds are spent.

Several countries in which we have operations provide meaningful incentives for research and experimental expenditures. We believe the United States should do likewise to encourage companies to perform their research here rather than be lured away by foreign incentives.

A strong domestic research establishment is vital to this country's economic health and provides new jobs for the future. We urge you to make a permanent part of the tax law.

Richardson-Vicks, Inc. is a worldwide manufacturer and marketer of consumer care products in the personal, health, nutritional and home care fields. We are headquartered in Connecticut and have our principal research facility there.

Very truly yours,

JOHN S. SCOTT,
President and CEO.

STATEMENT OF THE ROCHESTER TAX COUNCIL

SUMMARY OF PRINCIPAL POINTS

1. The Treasury has stated, correctly reflecting Congress's intent, that the goal of the R&E credit is to stimulate productivity-enhancing innovation.
2. Productivity-enhancing innovation is not found only on the assembly line; it is also found in the office and in other administrative areas. Computer systems, software as well as hardware, play a key role.
3. Productivity-enhancing innovation is not always incorporated in a product. Company-unique, innovative computer software, for instance, may never be sold to others, although its benefits will be passed on to consumers.
4. A rule eliminating all R&E credit for computer software used for administrative or office functions and not sold to others would be poor policy because the productivity-enhancing innovation described above that should be encouraged would not be eligible for the credit.
5. An example of an innovative, productivity-enhancing, administrative-function, non-product software development project of the Xerox Corporation, one of the Rochester Tax Council's members, is described at page 7.
6. The Rochester Tax Council and others, together with Treasury and legislative staff, have developed additional standards to add to those already incorporated in the Senate R&E credit amendment to H.R. 4170 (deleted in Conference) to help identify when internal-use software is innovative. The standards, to be added to the Senate's standards of experimentation and functional (rather than stylistic) improvement, are (1) substantial functional improvement or significant cost savings, (2) significant economic or commercial risk, and (3) not available for purchase.
7. The application of these standards will qualify for the credit only truly innovative software costs which constitute only a relatively modest amount of members' annual data processing development costs.

STATEMENT

This statement is submitted on behalf of the Rochester Tax Council, an organization representing the major employers in the Rochester, New York area including Bausch and Lomb, Champion, R.T. French, Gannett, Garlock, Gleason Works, Eastman Kodak, Security Bank, Schlegel, Sybron, and Xerox. If focuses on the fourth issue outlined in the Subcommittee's press release of June 4, 1984 announcing these hearings on the research credit: "whether the categories of qualifying research expenditures should be broadened or narrowed."

While the Rochester Tax Council appreciates the need for tightening the definition of qualifying research to avoid subsidizing non-innovative activity, it cautions against sacrificing broad categories of potentially crucial research activities for the sake of administrative comvenience. Specifically, the Council advocates the preservation as qualifying research expenditures certain costs of developing innovative computer software for the taxpayer's own use.

In advocating the preservation of the credit for such costs, the Council recognizes the need for providing standards for the qualification of software-related costs that are clearer than those provided by present law and that may be more exacting than even those proposed in the Senate amendment to H.R. 4170 (deleted by the Conference Committee) which redefined qualifying research. The Council, together with other concerned taxpayers, the Treasury and Senate and Joint Committee staff, has worked during the last several months to develop legislative history to provide such standards. A draft of that effort is attached as an apprndix to this statement. This statement analyses the rationale for the standards included in the Appendix and summarizes their effect.

In May 1983, before a Subcommittee of the Senate Finance Committee, former Assistant Treasury Secretary Chapoton testified that the goal of the R&E credit was to "encourage industry to undertake the risky research and innovation." We think this statement correctly reflects Congress's intent, as we understand it, in enacting the credit. The reason the government should provide such encouragement, Mr. Chapoton continued, is that the level of R&E motivated solely by the hope of future private profit frequently will be inadequate because businesses may not enjoy the full return to be realized from their innovation. In other words, the total return to society from R&E which leads to productivity-enhancing innovation is often, if not always, higher than the pre-tax economic return to the person conducting the R&E. A tax or other government-supplied incentive is, therefore, appropriate to help the person engaging in the R&E to defray his costs.

The natural focus on technological innovation is also sound; technological innovation does increase productivity. A recent Brookings Institution study shows that greater than 50% of the productivity increases in the United States in recent years has been due to technological innovation.

Justifying the credit, however, is far easier than identifying appropriate creditable activities to assure that the purpose of credit is carried out. Defining or quantifying the terms used to define the goal of the credit is difficult. What is "productivity-enhancing innovation"? How do we define "risky"? How much risk or innovation or improved productivity should we require? How "technological" should innovation be?

In answering these questions two crucial points must be kept in mind. First, productivity-enhancing innovation is not found only on the assembly line. Second, productivity-enhancing innovation is not always incorporated in a product.

Perhaps the greatest potential for substantial productivity gains lies not on the assembly line, but in the office. During the 1970's, for instance, manufacturing productivity increased by 90% while office productivity rose a mere 4%.[1] This indicates that we have barely begun to tap the potential for non-manufacturing productivity gains. This protential is also reflected in the fact that during the 1970's the wholesale price index, reflecting chiefly production costs, rose at a significantly slower rate than the consumer price index, reflecting the cost of non-production internal and external services. The costs of goods and services skyrocketed in the '70's more because of the inefficiencies of delivering those goods and services and not because the production of the goods itself was inefficient.

It is essential, therefore, that tax provision intended to increase productivity-enhancing innovation not ignore the productivity of the executive, the draftsman, the saleman, the manager, the accountant or the secretary. Indeed, these are the areas where the potential for productivity gains appears to be greatest.

Productivity gains, of course, remain important in the manufacuture and sale of products. Products such as computers, copiers, word processors, data communication equipment, and the like are all crucial. A great deal of research and development for improvements to these products is also crucial if American manufacturers are to remain the leading suppliers of the still-growing market for these products.

Productivity-enhancing innovation, however, does not stop with the production and sale of these machines. Rather, it includes the innovative and effective deployment and utilization of these machines in system—sometimes industry or company-specific systems—so that these machines can become efficient tools to increase the output of those who use them. It is this creative deployment and utilization that makes the "high tech" information management revolution a major force in enhancing productivity.

For automatic data processing equipment, better known as computers, to be deployed and utilized effectively, instructions that tell that equipment what to do and how to do it, known as software, must be carefully developed. Computer software, therefore, must be carefully developed. Computer software, therefore, can be as important to enhancing the productivity of the machine users as the machines themselves. No one knows better than the proud owner of a sophisticated new personal computer how useless that machine will be without sophisticated software. Yet the General Accounting Office study on the use and effectiveness of the research credit shows that one of the areas of greatest ambiguity in applying the R&E tax credit is whether certain computer software related activities quality. In eight of the ten disputes between taxpayers and the I.R.S. that GAO analyzed and for 30 of 92 taxpayers questioned, the qualification of software-related activities was an open question. Both the I.R.S. and taxpayers desperately need clarification in this area.

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[1] Gilder, *Wealth and Poverty* (1981) at pp. 209–10.

For any company with highly specialized data processing needs due to its size, its products, its workforce or other factors, some of its data processing systems will be unique to it. Not only will the particular combination of hardware often be unique, but the software that tells that hardware what to do and how to do it will be unique. For this reason, the software written for these unique system may not be available for purchase. Many larger companies rarely are able to purchase the innovative software which they require for internal use.

The Treasury, in searching for a new definition of "research and experimental" for credit purposes, has shown some caution in permitting these sorts of costs to qualify. This caution is based on fears that it may be difficult to administer properly credits where innovation and productivity improvements all take place inside a single organization and do not produce a tangible object susceptible to objective assessment.

Caution may be warranted. For the reasons outlined above, however, elimination of the credit for such costs due to an over-abundance of caution would be entirely unwarranted.

The costs of innovative, productivity-enhancing internally developed software for internal uses in management and administration are no less worthy of a tax credit than are innovative, productivity-enhancing hardware or other product development costs. Such costs are crucial to the effective use of computers and are incurred in the very area—the office—where productivity gains need to be the greatest. Equally important, these costs often involve significant risk and innovation.

The research and experimentation that lie behind the development of much software are often no less innovative than the research and development that go into the machines themselves. An example of an innovative, risky, productivity-enhancing non-product computer software development project of Xerox Corporation, a member of the Rochester Tax Council, demonstrates why the credit should be available for such costs.

Designing new products efficiently and quickly and getting those new products into production as quickly as possible are crucial to success in today's highly competitive business machines market. Technology moves so quickly that last year's products are rapidly obsolete. Consequently, Xerox must get its new designs into production very quickly. Xerox has spent considerable time and effort to shorten this process and to make it less costly.

As a step in this process, Xerox has invested heavily in an experimental computer-assisted product design system. Based on Secretary Chapoton's testimony of May 27, 1983 before the Senate Finance Committee we understand that there is little question that the software development costs for that computer-assisted design system itself would be eligible for the R&E credit. Because the computer-assisted design system is not electronically linked to Xerox's bill of material, product cost and parts procurement systems however, certain engineering and design documentation must still be manually created, retained, and transferred to those who must procure parts for the production of the new product and those who must price that product for sale to customers. This is time-consuming, error-prone and costly.

Xerox, therefore, initiated a project to create a computer link between its computer-assisted product design system and its bill of material, product pricing and part procurement systems. To create that link, Xerox software designers had to convert digital, graphic and textual information to standard codes which could be processed in a data base environment and also had to make adjustments to the normal data flow path within Xerox as well as to the data coding systems used by Xerox personnel.

The scope of this project is very large: by the time it is finished it will require an investment of 100 man-years as well as related new hardware costs of several million dollars, an amount easily in excess of a significant percentage of the annual costs of creating, retaining and transferring the hard-copy engineering documentation. Xerox believes that this substantial commitment of its resource indicates a significant commercial risk.

If successful, the new computer link made possible by he new software should speed up the product-costing and parts-procurement processes for a new product by a significant percentage, as well as reducing the cost of those processes by a significant percentage and eliminating many errors. In so doing, Xerox will use software in a fashion that is completely new to it and novel, at least in terms of scale, as compared to others in industry. Obviously, this software is not available for purchase on the open market.

There should be no question that a significant portion of the software research and development costs that go into this project should be eligible for the credit. Clearly, "experimentation" is involved and only functional, not stylistic improvement in data creation, retention and transfer are involved. In addition, the data creation, retention and transfer/utilization process will be made significantly speedier and more reliable and significantly less costly and therefore demonstrably innovative. The development of this computer software involves a significant commercial risk to Xerox. Finally, and obviously, this software is not avalable for purchase and could not be easily adapted from an software that was available for purchase. This new software is clearly "new" enough to qualify the costs of its development as "new or significantly improved" for credit purposes.

The members of the Rochester Tax Council are the first to admit, however, that all computer programming is not a risky or innovative activity. Some computer software development is not more than the simple translation of management tasks from manual-based to computer-based systems. Some may be the uncomplicated translation of instructions from one computer language to another, though this is not always uncomplicated. Still other software development costs may involve non-innovative preprogramming or the implementing aspects of applying innovative software in a non-innovative way such as where the computer instructions are innovative but the tasks performed are not.

The Treasury is concerned that the present definition of research and experimental for the R&D credit may be broad enough to permit a credit for such "mundane" activities. We understand and share that concern.

Partly in response to Senator Danforth's invitation to address these concerns, put forth in the statement introducing S. 2165 in November 1983, and partly as a result of an ongoing effort in response to the proposed R&D regulations of last year, the Rochester Tax Council and others have been working with Treasury and legislative staff to develop standards to distinguish the innovative internal software development costs from the non-innovative. The results of those efforts are attached to this statement in Appendix 1.

Appendix 1 is a draft of proposed Conference Report language for the Senate provision on the research credit that was included in H.R. 4170. Obviously, since the Conference rejected the Senate provision this language was not incorporated in the Conference Report on the Tax Reform Act of 1984. Should the Senate provision or some variant thereof be adopted in the future, however, we believe this joint Treasury-legislative staff-taxpayer effort should once again be considered for inclusion in legislation history and/or its precepts be included in the legislation itself.

The proposed conference report language is very narrowly drawn. It sets a very high threshold for qualification that we believe represents the strictest qualification test that can be adopted short of effectively disqualifying all costs of developing internal-use software. The draft language itself reflects the expectation that only 10 to 20 percent of a sophisticated company's internal-use software development and maintenance budget (that is not otherwise qualified)[2] would qualify under the standards proposed. Obviously, we believe that the draft standards represent significant concessions by taxpayers that more than adequately protect the Treasury from the danger of research credits being claimed for low-risk, non-innovative, internal-use software development cost.

The standards proposed to be added to the Senate-passed version of H.R. 4170 to distinguish innovative from non-innovative internal-use software development costs are relatively straightforward. In addition to the two standards already in the bill—the requirements of experimentation and functional, rather than stylistic, improvement—three additional standards are proposed.

First, the new or improved software must be truly and uniquely innovative, not a mundane or routine updating or modification. Such innovation could be proved by demonstrating that the use of the software results in a substantial reduction in the cost of performing the tasks the software helps perform or in a substantial improvement in (speed or other functional aspect to the extent provided in regulations) of the software. Regulations could provide other methods for proving significant innovation.

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[2] Which, for Xerox, translates to only approximately 5 percent of its total internal information management costs.

Second, the development or use of the new or improved software must involve significant commercial or economic risk. The appropriate risks include not only the operational feasibility of the program itself, but the commercial feasibility of the application of the program to its intended use. A substantial relative commitment of the firm's financial or business resources would help to establish commercial risk although generally there must be some risk due to technical exigencies that those substantial resources will not be recovered within a reasonable period.

Finally, the software must not be able to be purchased from others and used for its intended purposes without the sort of adaptation which would itself result in the new or significantly improved software.

While the percentages of total data processing costs that would qualify under these standards are small, the innovation obtained with those dollars which would qualify is extremely significant. The availability of the credit for these risky and innovative internal-use software expenditures is crucial for Rochester Tax Council members to continue to be able to make these expenditures. Obviously, in promulgating these proposed standards we recognize that many programming costs are not the risky innovative activity the R&E credit was meant to foster. We are certain the standards we proposed will virtually eliminate the potential for abuse of the credit while preserving it for these important innovative expenditures.

Appendix 1

EXCERPT FROM SENATE FINANCE COMMITTEE EXPLANATION [S. RPT. 98-169, VOL. 1] OF RESEARCH CREDIT PROVISION IN SENATE VERSION OF DEFICIT REDUCTION ACT OF 1984

COMPUTER SOFTWARE

"Under a special rule in the bill, computer software that is separately developed by or for the benefit of the taxpayer specifically for the taxpayer's own internal use qualifies as a business component (and hence the development costs of such software may be eligible for the credit) only if the software is used in (1) qualified research (as defined in sec. 44F(d)) undertaken by the taxpayer or (2) a production process that contains a component which qualifies for the credit (e.g., software for robotics used in operating an assembly line), or only to the extent allowed by Treasury regulations.

"Accordingly, the costs of developed software are not eligible for the credit where the software is used internally, for example, in general and administrative functions (payroll, bookkeeping, personnel management, etc.) or in providing noncomputer services (such as accounting, consulting, or banking services), except to the extent permitted by Treasury regulations. The committee intends and expects that these regulations will make the costs of technologically new or improved internal-use software eligible for the credit only where such software surmounts a high threshold of innovation as well as satisfying the general requirements for credit eligibility set forth in the bill."

DRAFT OF PROPOSED ADDITIONAL CONFERENCE REPORT LANGUAGE EXPLAINING SENATE PROVISION IN GREATER DETAIL

In adopting the research credit rule relating to computer software developed for internal-use, the Conference Committee intends and expects that Treasury regulations will provide that a taxpayer will be deemed to meet the standard of surmounting a high threshold of innovation if, and only if, the taxpayer establishes that all of the following three tests have been satisfied by the technologically new or improved software. (The Conference Committee intends that this three-part innovation standard cannot be avoided simply by showing a wholly secondary or incidental intent to sell, lease, or license computer software developed for internal use.) If the Treasury regulations set forth, in order to prevent avoidance of the purposes of the provision, any requirements which must also be met in addition to the following three tests, then any such additional requirements could only be applied on a prospective basis after publication of final regulations.

The first test requires the technologically new or improved internal-use software to be truly and uniquely innovative in a demonstrable manner. The Committee expects that the regulations will provide that this test would be satisfied where such software results in a substantial and economically significant reduction in cost or in a substantial and economically significant improvement in speed (or in certain limited functional aspects other than speed, but only if and to the extent specified in regulations). The determination of whether software has such results will depend on the cost or speed with which the software performs its intended business application. The determination also is to be made solely on the basis of results which are attributable to innovations in the new or improved software with respect to which the credit is claimed, independently of the effect of any modifications to related hardware or of other software not developed as part of the project. The regulations may provide for other limited circumstances in which true and unique innovations in software could meet this first test.

The second test requires the development or use of the technologically new or improved internal-use software to involve significant economic risk. One factor in establishing significant economic risk would be the expenditure of substantial amounts of funds, although the dollar amount of expenditures would not itself be a conclusive factor. Significant economic risk generally exists if both (1) the taxpayer commits substantial resources to development of the software and (2) there is an adequate doubt, due to technical risk, that those resources would be recovered within a reasonable period. Significant economic risk may be demonstrated in other ways but only if and to the extent specified in regulations.

The regulations should provide that, in appropriate circumstances, a commitment of substantial resources to the development of the software will be deemed made if the resources committed in developing the internal-use software are substantial in comparison with the annual cost of all of the specific functions (including allocable wage, overhead, and hardware costs), whether manual or automatic, that the results of such project will improve or replace. For example, assume a machine screw manufacturer undertakes to develop computer software to enable a machine to select from inventory the proper sized screws to fill customer orders. In determining whether a commitment of substantial resources has been made, a comparison could be made between the development costs for software and the taxpayer's costs incurred annually in wages and related warehouse operating costs (that would be eliminated or significantly reduced by the new computerized system) for stock clerks to make such selections manually.

A significant economic risk for internal-use software cannot be established by the risk that the internal-use software may not be successfully sold, leased, or licensed by the taxpayer to others.

The third test requires that the internal-use software must not be commercially available for use by the taxpayer. Software will be considered commercially available if it can be purchased, leased, or licensed and used for the taxpayer's intended purposes without the extent of adaptation which would itself (1) result in a substantial and economically significant important functional improvement over the available software and (2) involve significant economic risk. For example, the costs of altering or "translating" the purchased software's language to adapt the software to the taxpayer's computer hardware or software, or merely combining a number of software packages to produce software that would perform stipulated tasks for the taxpayer, cannot met this test (except for certain limited circumstances, but only if and to the extent specified in regulations). Moreover, the fact that the predominant portion of the software development costs is attributable to developing the software to the point that it accomplishes its intended application to specifications comparable to applications that are performed by software that can be purchased, leased or licensed is evidence that the resulting software should be treated as commercially available.

It is the Conference Committee's understanding that these tests will operate so that, in the case of taxpayers which make extensive use of technologically sophisticated in-house developed software, generally only 10 percent to 20 percent of the cost of developing internal-use software (other than software used in qualified research or in certain production processes) would be eligible for the credit. Of course, since the percentage in the case of any unusually highly sophisticated taxpayer could be greater, these figures are not intended to serve as a maximum limit allowable in the case of such a taxpayer. It is anticipated that for many taxpayers, the provision adopted by the Committee will operate to allow credit eligibility for no more than 10 percent (in many cases, none) of the costs of developing internal-use software.

If a software development project is abandoned without producing any usable results no costs of the project will qualify unless the taxpayer can demonstrate that, if successful, at least one of the alternatives considered would have met these three tests stated above. If a project produces some useful by-products but does not result in software which meets the three-part innovation standard described above, then only the portion (if any) of the development costs attributable to the failed innovative objective could qualify; the costs attributable to the results which do not satisfy the innovation standard could not qualify.

As stated, internal-use computer software satisfying these three innovation tests must also satisfy the general requirements for credit eligibility prescribed in the research credit provision adopted by the Committee to qualify for the credit. Thus, the specific exclusion from the definition of qualified research which are set forth in the conference agreement apply to internal-use software. Accordingly, without reference to the special criteria applicable in the case of certain internal-use software, software development costs which fall within the exclusions for duplication, adaptation, "debugging" or other post-research activities, etc. are not eligible for the credit. For example, no development costs will be eligible for the credit after otherwise qualifying internal-use computer software has been developed to the point where it either meets the basic functional and economic requirements of the taxpayer for such software, or is ready for internal use by the taxpayer.

Statement of Michael A. Lytle, Special Assistant to the Chancellor (Federal Relations), Texas A&M University System

I am Michael A. Lytle, Special Assistant to the Chancellor (Federal Relations) for The Texas A&M University System. I represent a major multi-campus/agency system created to serve the people of Texas and the nation. It is the state's land-grant university—part of that great educational experiment of 1864 designated to provide services and education ". . . to people of the working class." Well over 40,000 students enroll each year seeking degrees from the four academic institutions. In the areas of education, additional thousands benefit directly from the programs through the Texas Agricultural Extension Service and Texas Engineering Extension Service. Personnel at the two Experiment Stations, Agricultural and Engineering, and the Texas Transportation Institute are problem solvers, and their efforts contribute greatly to the economic and personal well-being of Texas citizens. The Texas Forest Service at and Texas Veterinary Medical Diagnostic Laboratory work directly with specific clientele throughout the State on specialized natural resource problems.

The Texas A&M University System, like other multi-campus higher education systems in the United States, is a large and complex organization. And, like other major public university systems with significant research programs the System receives substantial state appropriations. In addition, a meaningful and essential portion of our support is derived from gifts, and other contractual arrangements to provide research or specified services.

I shall continue to use the illustration of Texas A&M as a exemplar of a major research university. Certain generalizations can certainly be drawn to similar-type institutional settings.

Texas A&M University, our flagship institution, ranks first in research funding in Texas and the Southwest and is among the top 20 universities nationally, with an annual research expenditure of more than $102 million. Augmenting research activities is a 434-acre high technology research park now under development. The first major park occupant will be the Ocean Drilling Program of the National Science Foundation. More than 40 specified institutes or centers are on the campus, many of them interdisciplinary. They include:

Election Microscopy Center.
Center for Trace Chracterization.
Food Protein Research and Development Center.
Remote Sensing Center.
Center for Tropical Animal Health.
Themodynamics Research Center.
Institute for Venture in New Technology.
Center for Strategic Technology.
Institute for Solid State Electronics.

We consider Texas A&M University a creative environment on the campus of the leading research university in the Southwest, in which the tradition of research effort and achievement offers a specified and beneficial relationship between the university and private industry—a partnership for all seasons, for germinating fresh ideas and harvesting creative technologies. We have a deep and lasting interest in the importance of innovation to the economic growth and productivity of industry, academia, and at the national level.

We firmly believe there is a need for an enhanced tax incentive for corporate funding of university basic research. Texas A&M University, for example, is one of

33 major research universities involved in semiconductor research, partially funded by the Semiconductor Research Corporation (SRC). Our $116,000 funding is only a minor element of the $11,723,000 of SRC's current funding to the 33 institutions. Erich Bloch, Chairman of the Board of the Semiconductor Research Corporation has stated in recent testimony:

"While the response of SRC member companies under the existing tax credit incentive has been substantial, we strongly believe there is great potential for broad expansion of SRC's funding of university research is tax incentives for corporate support of such research is enhanced. In sum, SRC believes that the R&D tax credit must be made permanent. . . . Moreover, the differentially larger tax credit for corporate support of university research should be enacted to promote a substantially and fundamentally necessary increase for corporations to increase their funding of university research administration."

Mr. Paul Oosterhuis, speaking before the February 1 and 2, 1983 Government Research Corporation's conference, "High Technology Industries: Public Policies for the 1980's," has said that current tax policies reveal a number of issues which merit legislative concern if the encouragement of the growth of high technology companies in the 1980's is to be a high priority in the United States. Among these, Oosterhuis states, "the R&D tax credit should be made permanent and at the same time, perhaps expanded.

There is the strong intuitive feeling the R&D tax credit has benefits. Oosterhuis indicates, ". . . if the United States is truly serious about fostering an environment in which high technology companies can flourish and grow, bolder actions may be required." Quantifying these presents another set of problems. A Congressional Reference Service Brief 1B84004, "Industrial Innovation: The Debate Over Government Policy," reveals this finding:

"To date, research has not provided many concrete answers as to the extent and/or impact of the R&D tax credits an a firm's decision to increase research and development spending. However, private sector R&D funding increased during the recession and is expected to continue to do so. In light of this, several bills have been introduced in the 98th Congress which would extend or make permanent its R&D tax credit provisions of P.L. 97-34."

With concern for university basic research, The Texas A&M University System made its position known in a statement on the R&D tax credit provisions of S. 2165 and H.R. 4475, both entitled "High Technology Research and Scientific Education Act of 1983." Members of the Texas Congressional delegation were informed of this position statement.

It is generally felt that if high technology industries take advantage of the opportunities presented by R&D tax credit legislation, our colleges and universities will benefit in terms of increased industrial funding for research and more computers and other high technology equipment donated by industry.

There is some concern with legislative language, however. The disincentive to this legislation is the highly restrictive definition given to "basis research." For example, Title I of H.R. 4475, could have beeen interpreted as preventing "applied" research associated with a business item or product. This is restrictive to company in house qualifying research. Under Title II, Promotion of University Research and Scientific Education, the definition and "Basic Research" states: "any original investigation for the advancement of scientific knowledge not having specific commercial objective." This is viewed as so restrictive that strict interpretation would likely inhibit industry from conducting any substantial research with universities.

We have further stated our perception of five public policy benefits to the R&D tax credit:

(1) A university credit will encourage industry to support university basic research which, in time, makes U.S. products and processes more innovative and will enable American companies to compete more successfully in world markets.

(2) The Silicon Valley, Route 128 in Boston, and the recent MCC development in Austin, have demonstrated the economic benefits to a region when universities and companies collaborate in their research efforts. The R&D tax credit legislation provides the means by which other regions may develop economic development activities.

(3) Since basic research has few, if any, immediate commercial benefits, it is accepted public policy that its support is an appropriate federal responsibility. In the case of an R&D tax credit, such as provided in H.R. 4475, the federal share was only to amount to one-sixth of the total research cost.

(4) National security depends on science and technology. In recent decades the nation's security has become increasingly dependent upon the ability to maintain superiority in science and technology. As we face unprecedented challenges to our se-

curity, our capacity to sustain excellent research programs and to translate the products of research into technological advances is being severely challenged. Universities perform more basic research than any other institution in our society.

(5) Increased company sponsorship of university research will enable university graduate students to work in areas of specific interest to future employers. There is also a premise underlying this—that our future ability to meet challenges before us will depend in great measure upon the quality of our scientific and engineering research programs and upon our ability to meet the requirements for quality research and for highly trained engineers and scientists.

We support initiatives that will allow companies to make written agreements with universities for basic research and receive a 25% credit for 67% of the contract amount (a net credit of 16.25%). To reduce the revenue loss and to prevent companies from earning the credit for their present activities, the legislation should reward companies only for basic research expenditures that exceed existing levels or one percent of their qualified research budgets, whichever is greater. In other words, companies should benefit and for support of new projects, not those they are already funding. This is support for and R&D tax credit extension accompanied by an expanded deduction for equipment donated. We believe the tax credit for corporate, support of university research is imperative, including a 25 percent tax credit for increased corporate support of university, to be made permanent.

In closing, despite the pure advantages to the university sector which may result from the increased deduction for equipment donations to universities, and some difficulty about the restrictive conditions on types of research which may qualify, we find R&D tax incentives commendable. We are of the opinion, the intent of this legislation is an important measure for U.S. industry to compete in the international arena of high technology development, production, and marketing.

Statement of Mark Shepherd, Jr., Chairman of the Board, Texas Instruments Inc.

The U.S. economy is in the midst of one of the strongest recoveries in the post-war era, but many of this country's basic problems remain unsolved. Stable, long-term economic growth will ultimately depend on a sustained rise in productivity fueled by technological advances.

The backbone of technological innovation is research and development, and it is those countries with higher rates of growth of R&D expenditures that have experienced stronger productivity gains and higher GNP growth (See Fig. 1). The impact on productivity of a dollar spent for R&D can be several times greater than that of a dollar invested in conventional fixed capital. The flow of inventions and the translation of discoveries into commercially-feasible innovations have by no means ceased in this country. Yet, the West Germans and the Japanese are outdistancing us in the proportion of GNP spent in the critical area of civilian R&D, which excludes funds spent for defense and space exploration (See Fig. 2). While there may be long-term spillover benefits from these activities, the first priority in restoring U.S. competitiveness is redressing our inability to generate sufficient amounts of R&D directed at commercial applications.

Fig. 1

R&D SPENDING
IMPROVES ECONOMIC GROWTH

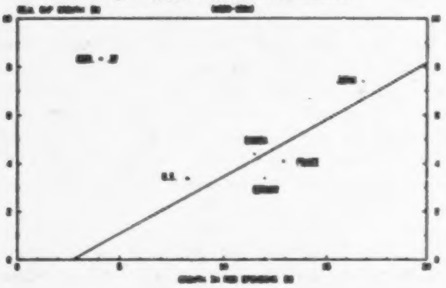
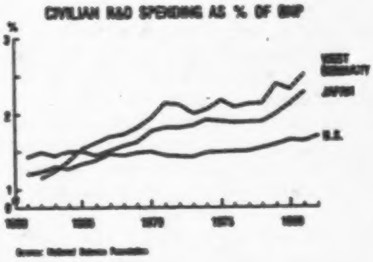


Fig. 2



An effective strategy to counter Japanese competitiveness is unlikely to evolve until Washington realizes that our real problem is neither Japanese protectionism nor the superiority of their technology. The true Japanese advantage stems from unique features of Japan's financial system that allow Japanese firms to succeed with only 1-2 percent after-tax profit on sales, instead of the 5-6 percent return that U.S. firms must earn to maintain investor confidence and access to borrowed capital. This difference in acceptable profit margins translates into extra funds available to our Japanese competitors for additional capital investment or research.

We cannot expect to offset this advantage by looking to the Japanese for changes. Instead, we should enhance the incentives for research and development in our own economy by strengthening current R&D tax credits. R&D

credits are far preferable to direct government funding or other forms of "industrial policy" because they not only provide the funds necessary to improve product and process technology but, at the same time, let the marketplace determine where the money goes. Consideration should also be given to a consumption tax, which would serve both as a correction to tax policies that discourage investment, and as an offset to tax revenues lost through reform.

The 1981 Economic Recovery Act, which included a temporary 25 percent incremental R&D tax credit, was a step in the right direction; but in its present form, it has several disadvantages. First, doubts about the permanence of the provision (it expires on December 31, 1985) have caused uncertainty regarding the advisability of factoring the credit into R&D budgeting decisions. Since R&D usually requires long-term commitments on the part of firms, a permanent credit would be more effective than a piecemeal approach. Second, the incremental nature of the provision can have perverse effects. Because this year's increased R&D spending raises the base over which next year's R&D must show an increase, the opportunity to qualify in future years is actually reduced by claiming the credit. To correct this unintended disincentive, the tax credit should be applied to total, rather than just incremental, R&D--a change not without cost. But a recent study by Data Resources Inc. indicates that the increased flow of revenues from the growing economy plus reduced financing costs from lower interest rates more than offset the measure's costs in the long run. (See Appendix)

Another major problem with the current R&D tax credit is the narrow definition of R&D costs eligible for the credit. Among other omissions, the definition of qualifying R&D activities does not encompass the critical area of "manufacturing R&D." A prototype does not mark the end-point of product development. The evolution from prototype to full-scale production requires the successful execution of four difficult steps: development of manufacturing processes, development of manufacturing machinery, building the plant, and training the people.

Often overlooked is the fact that the development of volume production equipment and processes may require more complex technology than the product development itself. The Japanese recognized some time ago the importance of this critical phase, and were able to commit more people and resources to it. As a result, they are beating us with their ability to take ideas into full-scale production in only half the time we require.

America's capacity for technological innovation constitutes a national resource that provides the foundation for our economic prosperity, national security, and competitive position in world markets. Today we are facing unprecedented challenges to our technological leadership, and we cannot allow these challenges to go unanswered. Our response must be to provide long-term strength to high technology and mature industries alike.

By enhancing R&D tax credits, along with the enactment of other policies that provide incentives for innovators, we can take significant steps toward assuring this country's continued technological leadership--and the economic benefits every American derives from that leadership--for years to come.

Whirlpool
CORPORATION

The Elisha Gray II
Research and Engineering Center
Benton Harbor, Michigan 49022

E. A. BAILLIF
VICE PRESIDENT

November 4, 1983

The Honorable Charles B. Rangel
Chairman, Subcommittee on Oversight
Committee on Ways and Means
U.S. House of Representatives
Washington, D.C. 20515

Dear Chairman Rangel:

Whirlpool Corporation submits the enclosed comments in support of legislative action by the Committee to indefinitely extend the 25% R&D tax credit. We understand that this issue is the subject of current hearings.

We strongly believe that intensified research efforts are key to the U.S. bettering its competitive position in the world market. Only through committed R&D efforts will industry improve productivity, enhance manufacturing processes, and optimize product design.

Please contact me if we can provide further information in support of the 25% R&D tax credit.

Sincerely,

EAB/kp
Enc.

APPENDIX

A study by Data Resources Inc. (DRI), sponsored by TI in early 1984, indicates that the introduction of a 25% tax credit on total R&D expenditures would boost the level of R&D by an average of 16% per year and raise the annual level of productivity by 0.7% in the first decade after enactment. In the second decade, R&D spending would be 24% higher per year and productivity would be 2.9% higher each year.

Macroeconomic Effects of a Tax Credit on R&D
(Average annual change to baseline forecast)

	1985-1994			1995-2004		
	25% Increm	10% Full	25% Full	25% Increm	10% Full	25% Full
R&D Spending (%)	1.8	6.2	16.0	2.7	9.0	24.1
Productivity Gains (%)	0.1	0.3	0.7	0.3	1.1	2.9
Real GNP Growth (%)	0.1	0.3	0.7	0.3	1.0	2.6

The effects on the federal government deficit are, of course, very important. For example, in the first year of enactment the credit causes an increase in the deficit by about $13 billion. Eventually, however, the increased flow of receipts from the larger economy offsets the cost of R&D tax credits. From 1996 on, the effect on the deficit is favorable and from 2001 on the cumulative effect is favorable. By 2003, the cumulative improvement to the deficit is about $300 billion. This effect on the deficit stems not only from greater tax receipts but also from lower interest payments, due to eventually lower interest rates.

Impact of 25% Tax Credit on Budget Deficit
($B)

1984	+	$13.1	1989	+	$18.6	1994	+	$9.0	1999	$ (45.0)
1985	+	14.7	1990	+	18.8	1995	+	0.9	2000	(62.5)
1986	+	15.1	1991	+	17.8	1996		(7.3)	2001	(80.9)
1987	+	16.0	1992	+	15.2	1997		(14.4)	2002	(99.5)
1988	+	17.1	1993	+	12.7	1998		(25.5)	2003	(120.4)

These results indicate that R&D tax credits yield positive returns to society as well as to private firms.

STATEMENT OF THE WHIRPOOL CORP.

Whirlpool Corporation, the world's leading producer of major home appliances for the U.S. marketplace, has a key interest in the Subcommittee's deliberations concerning continuation of the 25% research and development tax credit which was established by the Economic Recovery Tax Act in 1981.

Due to Whirlpool's significant financial commitment to R&D activities, we urge the Committee to extend the use of the credit indefinitely. The R&D federal tax credit for 1982 resulted in a tax benefit to Whirlpool of $601,672.

We believe that the tax credit should be continued for several reasons. First, we are aware that the U.S. home appliance market (approximately 27 million units shipped this year) represents a tremendous marketing opportunity for foreign appliance makers -- particularly the Japanese. Many of the products (particularly microwave ovens, refrigerators) in competition with domestically produced units represent state-of-the-art technology in both features and manufacturing processes. In order to remain competitive -- and keep employment stable -- we must devote an ever increasing share of our sales dollars to research programs. Research projects which contribute to increased manufacturing productivity are particularly important in helping us to increase productivity and thereby successfully compete with imported products. In the area of product features, advances in electronics place additional emphasis on research programs aimed at keeping Whirlpool competitive.

Another driving force behind our plans to make heavy investments in R&D is a continuing commitment to designing major home appliances that use less energy. Ever since 1975, we have been under the threat of regulatory energy efficiency standards by both the federal and state governments. Although much of this regulation has failed to materialize, we've taken the initiative to improve the energy efficiency of our refrigerators by 78%; freezers 75.6%; clothes washers 71.5%; and dishwashers 28%. The point is, much of this progress is attributable to recent R&D programs. Further efficiency gains will be difficult without continued commitment to product research. Clearly, continuation of the credit will be an incentive to continue emphasis on these research programs.

The Committee should also be aware that recently proposed IRS regulations (48 FR 2799) would vitiate the favorable effect the original legislation was intended to have. Contrary to the legislative history of the law, the regulations would bar credit for ventures into new businesses, so-called "routine" product improvements, and most computer software improvements. These efforts to restrict the credit should be rectified by explicit statutory language to permit inclusion of the type of projects originally envisioned by the authors of ERTA. Our arguments and concerns are reviewed in detail in the enclosed comments filed with the IRS.

WHIRLPOOL CORP. IN RESPONSE TO THE NOTICE OF PROPOSED RULEMAKING REGARDING PROPOSED REG. §§ 1.44F-1 THROUGH 1.44F-7 AND A PROPOSED AMENDMENT TO REG. § 1.174-2 RELATING TO THE CREDIT FOR INCREASING RESEARCH ACTIVITIES (48 FR 2799)

I. Introduction

Whirlpool Corporation, a leading manufacturer and marketer of major home appliances, herewith submits its comments in response to the Notice of Proposed Rulemaking regarding Proposed Regulations §§ 1.44F-1 through 1.44F-7 and a Proposed Amendment to Reg. § 1.174-2 relating to the credit for increasing research activities. Whirlpool operates a central facility devoted exclusively to research and development activities and also conducts extensive research activities in each of its manufacturing divisions. Whirlpool has for many years made substantial research expenditures and has an ongoing committment to research. Thus, we have a deep interest in these proposed rules.

Our comments will focus on three areas: the trade or business requirement found in Prop. Reg. § 1.44F-2(a)(1), the exclusion of expenditures for certain costs enumerated in the Proposed Amendment to Regs. § 1.174-2(1), and the treatment of the costs of developing computer software in the Proposed Amendment to Reg. § 1.174-2(a)(3).

II. The Trade or Business Requirement

§ 44F(b)(1) provides: "(b) Qualified Research Expenses. - For purposes of this section - (1) Qualified research expenses. - The term 'qualified research expenses' means the sum of the following amounts which are paid or incurred by the taxpayer during the taxable year in carrying on any trade or business of the taxpayer -" (Emphasis added). However, while the statute speaks of expenses paid or incurred in carrying on any trade or business, Whirlpool has concerns regarding Prop. Reg. § 1.44F-2(a)(1) which states that "A research expense must relate to a particular trade or business *** ." The proposed regulation further states at § 1.44F-2(a)(2) "Thus, research expenses paid or incurred by a taxpayer in developing a product the sale of which would constitute a new trade or business of the taxpayer are not paid or incurred in carrying on a trade or business." (Emphasis added).

Whirlpool submits that the regulation should specify "any" trade or business carried on by the taxpayer, and should not preclude the development of a product which would give rise to a new trade or business. Thus, the proposed language "particular" is inconsistent with the statutory language specifying "any" trade or business. To so limit the application of the research credit through a restriction to the "particular" trade or business carried on by the taxpayer could severely curtail the effectiveness of the research credit provisions.

By way of illustration, a taxpayer's research facility engaged in pure research may well invent and develop a product or process which is totally unrelated to the trade or business in which the taxpayer is engaged. Yet, this research effort would, through the subsequent production of the new product or process, as desired by Congress (House Report 97-201, 97th Cong., 1st Session (1981) at page 111), "stimulate a higher rate of capital formation and *** increase productivity"). Whirlpool believes that the research credit should not be denied to the taxpayer in this instance.

Another example might involve a taxpayer which is a member of a controlled group filing a consolidated income tax return. It appears that the proposed regulations would deny the research credit to the taxpayer if its research efforts result in a new product relating to a trade or business carried on by another member of the controlled group which is in a different trade or business from that of the taxpayer which developed the new product. Again, the intent of Congress would be frustrated because of the artificial barrier of the regulations in insisting, through the use of the work "particular", that the taxpayer accomplish its research activities within its own "particular" trade or business.

III. The Exclusion of Expenditures for Certain Costs

Present Reg. § 1.174-2(a)(1) defines research and experimental expenditures for purposes of § 174 as "research and development costs in the experimental or laboratory sense. The term includes generally all such costs incident to the development of an experimental or pilot model, a plant process, a product, a formula, an invention, or similar property, and the improvement of already existing property of the type mentioned. **** The term includes the cost of obtaining a patent, such as attorney's fees expended in making and perfecting a patent application."

The same regulation goes on to specify those expenditures which do not represent research and development costs as "expenditures such as those for the ordinary testing or inspection of materials or products for quality control or those for efficiency surveys, advertising, or promotions. ***."

The Senate Report (No. 97-144, 97th Cong. 1st Session (1981) at Page 81) states that "It is anticipated that the Treasury and the Internal Revenue Service, pursuant to authority to issue interpretive regulations and rulings (Code sec. 7805), will provide additional guidance, not inconsistent with existing regulations, defining research for purposes of new section 44F and section 174". (Emphasis added).

The proposed amendment to Regs. § 1.174-2(a)(1) carves out costs pertaining to routine or periodic improvements to already existing products, commercial production lines, or other ongoing operations as costs which are not included in the definition of research and experimental expenditures. Also excluded are the costs of copies of prototypes after construction and testing of the original prototype has been completed.

Whirlpool believes that the direction given by the Senate Report and the wording of present Reg. 1.174-2(a)(1), in its first paragraph, clearly intend that all improvements to already existing property should qualify as research and experimental expenditures. Routine or periodic improvements should not be excepted, nor should the magnitude of the expenditure in any way control. For example, any development which improves product energy efficiency should qualify. Whirlpool does not believe that example (1) in proposed Reg. 1.174-2(a)(2) is corrent or appropriate. A similar argument can be made as to example (3). It is clear that a new plant process is intended to qualify.

Whirlpool also believes that the regulations should apply to the construction of more than one prototype. In many cases, in the consumer products field, multiple prototypes are required in the development of a new product before the product has been developed to the point of commercial feasibility. Thus, costs incurred for prototype or pilot models constructed prior to production for sale to the general public are research expenditures in the laboratory or experimental sense and should qualify.

IV. The Treatment of Costs of Developing Computer Software

The proposed amendment to Regs. § 1.174-2(a) adds new paragraph (3) which states that "Generally, the costs of developing computer software are not research or experimental expenditures within the meaning of section 174." Whirlpool believes that such initial characterization of the costs of computer software is inappropriate.

Further, the introduction of criteria such as operational feasibility, the risk of unsuccessful completion of the work, or the use of well-known programming techniques is contrary to the basic intention and thrust of the first paragraph of the proposed amendment to Regs. § 1.174-2(a)(1). It appears that the proposed amendment more closely reflects the House definition of research expenditures, which was based on Financial Accounting Standards Board (FASB) Statement No. 2, than it reflects the bill as finally enacted.

In the statute as finally enacted, Congress clearly rejected the FASB definition.

In short, Whirlpool believes that the question of qualification of the costs of developing computer software as research and experimental expenditures should be decided on the facts of each situation, in the same way that qualification of other costs is decided.

CONCLUSION

Whirlpool is hopeful that these comments will assist the Internal Revenue Service in developing final regulations which will be equitable to taxpayers and which will relfect the intentions of Congress.

APPENDIX

Canadian Tax Paper No. 70 February 1983

Canadian R & D Incentives: Their Adequacy and Impact

Donald G. McFetridge
Jacek P. Warda

Canadian Tax Foundation
L'Association Canadienne d'Études Fiscales

Foreword

Canadian expenditures on research and development as a percentage of gross national product have been substantially below those of most developed countries in recent years. Many who believe that the future growth of the economy will depend increasingly on Canadian participation in technological innovation favour more liberal treatment of R & D. In their view, the Canadian tax system presently does not offer enough incentive to engage in R & D and, one way or another, it must offer more. The purpose of this study is to compare the R & D incentives provided by Canada with those of other countries in an attempt to determine whether the Canadian tax system in particular, and government policy in general, are sufficiently favourable for the conduct of R & D.

The authors discuss both the current corporate tax treatment of R & D in Canada and its evolution over time, and compare Canadian tax policies toward R & D with those prevailing in the major industrialized countries, some small developed countries, and some relatively advanced developing countries. They also consider the extent to which support for R & D is channelled through subsidies and government contracts. Further, even if the Canadian corporate tax system treated R & D more favourably than did the tax systems of other countries, the authors discuss whether R & D should be treated even more liberally, having regard to the relative social and private rates of return on R & D compared with other forms of investment.

Their conclusion is that, insofar as the corporate tax system is concerned, the R & D incentives Canada offers are superior to those in all but one of the twenty countries examined (the exception is Singapore). When subsidies and R & D contracts are taken into account, the incentives in place in Canada are among the most generous, if not the most generous, they have been able to find. A case for even more generous government support for R & D activities may be difficult to make, however, in the light of the ease with which technology that is developed in one location may be used without compensation in many others. In the authors' view, it is not necessarily in Canada's interest to provide for substantially more generous tax treatment of R & D than do other industrial countries.

Donald G. McFetridge is Professor of Economics at Carleton University and has written previously on R & D. Jacek P. Warda is a graduate student in the Department of Economics at the same university.

The authors are grateful to Richard M. Bird, Robin W. Boadway, Allan M. Maslove, and Neil Swan for their comments and suggestions. The manuscript was edited by Frances H. Emery. References were verified and the index was prepared by Linda Jerome.

As with other Foundation publications, the views expressed in this volume are those of the authors and should not be ascribed to the Foundation or its members or to any of those who commented on the manuscript.

D. J. Sherbaniuk
Director
February 1983

Contents

Foreword iii

1 **Introduction** 1
The Purpose of the Study 1
The Recent Literature on the Economics of R & D 4

2 **The Elements of the Tax Environment of R & D** 11
A Summary Measure of the Impact of National Tax Systems on the R & D Decision: The B-Index 17
The Economic Implications of International Differences in the B-Index 21
The Components of an Average R & D Dollar 25

3 **The R & D Tax Environment in Canada** 30
Evolution of the Tax Treatment of R & D 30
The After-Tax Cost of R & D and the B-Index 33
  Canada Over Time 33
  Canada by Region, Firm Size, and Type of R & D Activity 37
The Impact of the Tax System on the Choice Between R & D and Physical Capital 42

4 **The R & D Tax Environment in Other Countries** 45
Major Industrial Countries 45
  The United States 45
  The United Kingdom 47
  The Federal Republic of Germany 47
  France 48
  Japan 49
Some Small Developed Countries 50
  Austria 50
  Australia 51
  Belgium 51
  Denmark 53
  Italy 53
  Norway 54
  Spain 54
  Sweden 55
  Other Small Developed Countries 57

Some Less-Developed Countries 59
  Brazil 59
  Mexico 59
  Hong Kong 60
  South Korea 60
  Singapore 61
  Taiwan 62

5 **Implications of the Analysis of Tax Measures** 63
Tax Arrangements Relating to R & D: A Summary 63
The B-Index 70

6 **Other Types of Government Support of R & D** 78
Subsidies 80
Contracts and Their Impact on the B-Index 80

7 **The Adequacy of Canadian R & D Incentives: Applying an Absolute Standard** 84

8 **The Impact of R & D Incentives on R & D Spending** 88

9 **Conclusions** 90

Bibliography 93

Index 98

LIST OF TABLES

2.1 Intramural Industrial R & D in Canada, 1972-1981 26
2.2 The Composition of Intramural R & D Expenditures in OECD Countries, 1977 27
2.3 Payments for Extramural Industrial R & D—Canada, 1970-1979 ... 29
3.1 The After-Tax Cost of R & D and the B-Index—Canada, 1952-1981 35
3.2 The After-Tax Cost of R & D and the B-Index with Variable Corporate Tax Rates—Canada, 1952-1982 36
3.3 The After-Tax Cost of R & D and the B-Index by Characteristics of Firm and R & D, 1981 38
5.1 The Tax Treatment of R & D—Canada vs. Major Industrial Countries 64

5.2 The Tax Treatment of R & D—Canada vs. Small Developed Countries 65

5.3 The Tax Treatment of R & D—Canada vs. Less-Developed Countries 66

5.4 The Minimum Benefit-Cost Ratio at Which R & D Is Profitable—Results for 20 Countries, 1981 72

6.1 Government Subsidies as a Percentage of Industrial R & D Spending—P(S) 81

6.2 Subsidies, the Subsidy Element in Contracts, and the B-Index in 12 Countries 82

1

Introduction

The Purpose of the Study

Great pressure has been placed on the Government of Canada to provide more incentives for industrial research and development (R & D). The Canadian Chamber of Commerce has argued that ". . . present incentives in Canada are extremely low, compared with those of other industrial nations, and are barely sustaining current activity."[1] The Chamber has claimed that the Government of Canada finances only 11 per cent of the industrial R & D conducted in Canada, while Japan supports 90 per cent of the R & D in key sectors, Germany 80 per cent, France and the United States 60 per cent, the United Kingdom 50 per cent, and Sweden 45 per cent.[2] As a response to this disparity in support, the Chamber of Commerce recommended that additional tax incentives be offered. In its view, the magnitude of these incentives should be such as to result in out-of-pocket costs of 10 to 15 cents per dollar spent on industrial R & D.[3]

The Chamber of Commerce is but one of many groups advocating the liberalization of tax incentives for R & D. A task force appointed by the Government of Nova Scotia recently recommended that, among other things, 150 per cent of R & D expenditures should be deductible from taxable income and that the existing R & D tax credit should be increased to 30 per cent and made nontaxable.[4] The implementation of these Nova Scotia task force recommendations would certainly achieve the goals of the Chamber of Commerce. Indeed, it would reduce the after-tax cost of R & D to one cent on the dollar.

Some other very careful studies have advocated less sweeping changes in the tax treatment of R & D. Rather than changing the incentives that are available, some investigators, Strain[5] for example, have suggested ways of making it easier for firms that have unused credits and allowances to collaborate with firms that have taxable income.

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[1] James Rush, "Chamber Urges Tax Incentives," *The Globe and Mail*, October 23, 1980, B1.

[2] Canadian Chamber of Commerce, "Research Initiatives, A Submission to the Minister of State for Science and Technology" (mimeograph, Canadian Chamber of Commerce, Montreal, 1980), 2.

[3] Ibid., at 8.

[4] Lyndon Watkins, "N.S. Task Force Urges Extension of Existing R and D Incentives," *The Globe and Mail*, July 4, 1981, B2.

Regardless of their motives and the care they invest in their analyses, the starting point for all the advocates of more liberal tax treatment of R & D is that the Canadian tax system presently does not offer enough incentive to engage in R & D and that, one way or another, it must offer more. The purpose of this study is to examine the premise that the Canadian tax system in particular, and government policy in general, are not sufficiently favourable toward the conduct of R & D.

A number of alternative standards might be used to assess the sufficiency of Canadian support for R & D. The first possibility is to compare the R & D provisions of the Canadian tax system with those in effect in other countries. Do other countries offer credits and allowances that Canada does not? Are other countries more flexible regarding when deductions may be taken? If the answer to these questions is no, then there is less reason to support the liberalization of the Canadian system.

A finding that Canada's tax treatment of R & D is more or less generous than that of other countries does not provide a definitive answer to the question "is there sufficient incentive for R & D in Canada?" First, there is some evidence that other countries look to Canada for guidance in their tax treatment of R & D.[6] Second, national tax systems are so complex and the incentives they offer so subtle and often so well disguised that an international comparison of a few aspects of corporate taxation may not tell us very much. Third, it may also be true that in some countries government support for R & D is channelled through subsidies, contracts, and myriad informal arrangements between business and government. This last problem is dealt with, in part, in this study. In addition to the tax treatment of R & D, we investigate the extent to which industrial R & D is supported by subsidies or government R & D contracts in other countries. Again this comparison is restricted. It is very difficult to assess the net impact on the cost of R & D of the various general investment and regional development tax concessions and subsidies offered by national, let alone local, governments.

The comparison of Canadian tax, subsidy, and contract policies toward R & D with those of other countries requires a general or summary measure of the net tax incentive to engage in R & D. In this study we derive a summary measure, which we call the B-index. The B-index is used as the basis for discussion of both the current tax treatment of R & D in Canada, and how it has evolved over time. We then employ the B-index for the purpose of comparing Canadian tax policies toward R & D with those prevailing in: (1) the major industrial countries, including the United States, Japan, Germany, the United Kingdom, and France; (2) some small developed countries including Austria, Australia, Belgium, Denmark, Italy, Spain, Sweden, and Norway; and (3) some relatively advanced developing countries including Brazil, Hong Kong, Korea, Mexico, Singapore, and Taiwan.

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[5] William J. Strain, "Tax and Other Incentives to Reduce R & D Costs," in *Current Developments in Measuring Business Income for Tax Purposes*, Corporate Management Tax Conference, 1981 (Toronto: Canadian Tax Foundation, 1982), 227-54, at 246-48.

[6] R. N. Mattson, "R & D Tax Policy" (January 1978), 21 *Research Management* 24-27; Australia, Committee of Inquiry into Technological Change in Australia, *Technological Change in Australia*, Selected Papers on Technological Change, Vol. 4 (Canberra: Government Publishing Service, 1980); M. Ishaq Nadiri, *Evidence and Effectiveness of Tax Incentives to Promote Innovation* (Working paper, New York University, Department of Economics, 1981).

Having assessed the extent of the R & D incentive provided by the tax systems of these countries, we ask whether the incentive ranking we have inferred would be changed if subsidies and R & D contracts were considered. This necessitates a discussion of the extent, if any, to which an R & D contract can be considered support of R & D. That is, what is the subsidy component of an R & D contract? The result of this part of our investigation is an international ranking of tax incentives for R & D, and of tax, subsidy, and contract incentives under various assumptions about the subsidy component of an R & D contract.

As we conceded above, Canadian tax treatment of R & D might be found to be relatively generous by international standards and yet not be sufficiently favourable by some absolute standard. Suppose, for example, that one of the purposes of the tax system is to contribute to efficient resource allocation. Resources are deemed to be allocated efficiently when *ex ante* marginal social rates of return are equalized across all types of investment activity. If the marginal social rate of return on R & D exceeds the return on other forms of investment, there is an underallocation of resources to R & D.

Circumstances could arise in which, although Canada's tax system treated R & D more favourably than did the tax systems of other countries, its net allocative impact was such as to leave the marginal social rate of return on R & D higher than the return on other forms of investment. In this case, allocative efficiency would require an even more favourable tax environment for R & D.

It is generally argued that, because the principal result of R & D is the production of information, the use of which cannot readily be restricted, the private return on R & D will be smaller relative to the social return than is the case with other forms of investment. If the tax system were to treat all forms of investment activity identically and if private after-tax rates of return on all investment activities were equalized at the margin, the marginal social return on R & D would exceed the marginal social return on other forms of investment. Given the inappropriability of the returns on R & D, resource allocation decisions that are privately efficient are not socially efficient. This situation can be corrected by according more favourable tax treatment to R & D than to other forms of investment.

The relevant question is then whether R & D is, in fact, treated more favourably for tax purposes than other forms of investment, and, if so, if the difference in tax treatment is sufficient to offset the relative inappropriability of the returns on R & D. In Chapter 7 of this study, we use an estimate of the ratio of the social to the private (before-tax) rate of return on R & D derived from the work of Mansfield et al.,[7] and B-indexes calculated for both R & D and a representative alternative investment, in an attempt to answer this question.

In sum, this study assesses the adequacy of Canada's tax and other federal incentives for R & D in both relative and absolute terms. Canada's incentives are adequate in relative terms if they are as generous as those of other countries facing similar circumstances. Canadian incentives are adequate in absolute terms if they are sufficient to compensate for the relative inappropriability of the returns on R & D.

The study also makes an attempt to estimate the impact of Canadian R & D incentives on Canadian R & D spending. The approach taken here is to estimate the amount of R & D spending that would have been undertaken by manufacturing firms if R & D were treated the same for tax purposes as an average investment in plant and equipment. The results of this exercise are reported in Chapter 8.

While the economic analysis in the study is neither technical in nature nor particularly difficult, some readers may wish to concentrate their attention on the institutional details of the tax treatment of R & D in Canada and abroad. They can do so by proceeding directly to the first section of Chapter 3 for the details of Canadian tax treatment of R & D, and to Chapter 4 for the tax treatment of R & D by other countries. The ranking of the degree of support accorded R & D by the tax systems of the countries examined is reported in Chapter 5. The ranking of the degree of support accorded R & D by the tax and subsidy systems of the countries examined is reported in Chapter 6.

The Recent Literature on the Economics of R & D

The literature on the economics of R & D can be divided into four categories. The first is comprised of studies reporting the existence of statistical relationships between R & D expenditures and other economic variables such as employment, exports, and foreign ownership.[8] Studies of this type have been discussed by McFetridge.[9] They indicate only that R & D expenditures are related to some other economic variable. They say nothing about causality and do not indicate whether the observed relationship would continue to be observed if the effects of other relevant variables were taken into account. Finally and perhaps most importantly for present purposes, this type of study provides no insight into whether the allocation of additional resources to R & D constitutes a higher valued use of those resources. If public policy has as its goal the efficient allocation of resources, it receives no guidance from this type of study.

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[7] Edwin Mansfield, John Rapoport, Anthony Romeo, Edmond Villani, Samuel Wagner, and Frank Husic, *The Production and Application of New Industrial Technology* (New York: Norton, 1977).

[8] See William N. Leonard, "Research and Development in Industrial Growth" (March-April 1971), 79 *Journal of Political Economy* 232-56; William Gruber, Dileep Mehta, and Raymond Vernon, "The R & D Factor in International Trade and Industrial Investment of United States Industries" (February-December 1967), 75 *Journal of Political Economy* 20-37; Alan M. Rugman, "Research and Development by Multinational and Domestic Firms in Canada" (Autumn 1981), 7 *Canadian Public Policy* 604-16, and references therein.

The second type of study models the R & D decision itself. Examples of this type of study are Grabowski and Mueller, Grabowski and Baxter, and, more recently, Bernstein and Nadiri.[10] The essential purpose of these studies is to test alternative theories of the firm and/or market organization. While they are interesting in themselves, they have no direct bearing on issues of tax and subsidy policy.

Studies of the third type attempt to calculate private and, occasionally, social rates of return on R & D. Some studies apply the techniques of project evaluation to the R & D decision, calculating internal private and internal social rates of return.[11] These studies are relevant to the discussion of the tax treatment of R & D insofar as they provide a measure of the discrepancy between the social and private rates of return on R & D at the margin. The greater the observed excess of the social over the private rate of return on R & D, the better the case to be made, on efficiency grounds, for greater tax or other R & D incentives. In Chapter 7 of this study the adequacy of existing Canadian R & D incentives is assessed in the light of the evidence assembled by Mansfield et al.[12] on the excess of social over private rates of return on R & D.

Another approach to the calculation of social and private rates of return on R & D is to infer the marginal product of R & D from statistical production functions. A general discussion of the many problems associated with this approach can be found in Griliches.[13] A recent example of this approach is provided by Nadiri.[14] The latter estimates a production function for the U.S. manufacturing sector. The arguments of the function are the stock of R & D (accumulated R & D expenditures), the stock of physical capital, and the total number of workers employed. As Nadiri[15] explains, the respective marginal social rates of return on R & D and physical capital can be inferred from the estimates of the parameters of the function. Although there is some ambiguity associated with his results and although they are highly tentative, they do appear to imply that the marginal social return on R & D exceeds the marginal social return on physical capital. This implies, in turn, that there is an underallocation of resources to R & D in the United States, which could be corrected by more generous tax treatment or by greater subsidization of R & D.

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[9] D. G. McFetridge, *Government Support of Scientific Research and Development: An Economic Analysis*, Ontario Economic Council Research Studies 8 (Toronto: published for the Ontario Economic Council by University of Toronto Press, 1977), 23-36.

[10] Henry G. Grabowski and Dennis C. Mueller, "Managerial and Stockholder Welfare Models of Firm Expenditures" (February 1972), 54 *Review of Economics and Statistics* 9-24; Henry G. Grabowski and Nevins D. Baxter, "Rivalry in Industrial Research and Development: An Empirical Study" (April 1973), 21 *Journal of Industrial Economics* 209-35; Jeffrey I. Bernstein and M. Ishaq Nadiri, "Research and Development and Capacity Utilization" (mimeograph, Carleton University, Department of Economics, Ottawa, 1982).

[11] Edwin Mansfield and Richard Brandenburg, "The Allocation Characteristics and Outcome of the Firm's Research and Development Portfolio: A Case Study" (October 1966), 39 *Journal of Business* 447-64; Edwin Mansfield, John Rapoport, Jerome Schnee, Samuel Wagner, and Michael Hamburger, *Research and Innovation in the Modern Corporation* (New York: Norton, 1971); supra footnote 7.

[12] Supra footnote 7.

Relatively few of those using the production function approach to the measurement of returns on R & D have worked on aggregate (economy-wide) data. Most investigators have used firm- or industry-level data. Recent studies of this nature are Griliches, Terleckyj, Link, and Griliches and Mairesse.[16] References to earlier studies are contained in McFetridge.[17] These studies provide estimates of private but not social rates of return on R & D. That is, they do not take into account benefits that R & D confers upon other firms or industries. Nor do they take full account of the benefits that the firms or industries examined have received from the R & D of others.

Although there are some problems of interpretation,[18] these studies generally find that private before-tax rates of return on R & D are quite high, ranging upwards from 30 per cent. One might infer from this that R & D has been a comparatively good investment and that firms ought to do more of it. Alternatively one might infer that this is the rate of return firms require if they are to bear the risks associated with R & D. In this case firms are doing as much R & D as is profitable given the risks involved.

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[13] Zvi Griliches, "Issues in Assessing the Contribution of Research and Development to Productivity Growth" (Spring 1979), 10 *The Bell Journal of Economics* 92-116.

[14] M. Ishaq Nadiri, "Contributions and Determinants of Research and Development Expenditures in the U.S. Manufacturing Industries," in George M. von Furstenberg, ed., *Capital, Efficiency and Growth* (Cambridge, Massachusetts: Ballinger, 1980), Chapter 5.

[15] Ibid., at 383.

[16] Zvi Griliches, "Returns to Research and Development Expenditures in the Private Sector," in John W. Kendrick and Beatrice N. Vaccara, eds., *New Developments in Productivity Measurement and Analysis*, Studies in Income and Wealth, Vol. 44 (Chicago: University of Chicago Press, 1980), 419-54; Nestor E. Terleckyj, "Direct and Indirect Effects of Industrial Research and Development on the Productivity Growth of Industries," in ibid., at 359-77; Albert N. Link, "Firm Size and Efficient Entrepreneurial Activity: A Reformulation of the Schumpeter Hypothesis" (August 1980), 88 *Journal of Political Economy* 771-82; Zvi Griliches and Jacques Mairesse, *Productivity and the R & D at the Firm Level*, Discussion Paper Series no. 891 (Cambridge, Massachusetts: Harvard University, 1982).

[17] See generally, supra footnote 9.

[18] See A. Pakes and M. Schankerman, *The Rate of Obsolescence of Knowledge, Research Gestation Lags, and the Private Rate of Return to Research Resources*, Discussion Paper no. 659 (Cambridge, Massachusetts: Harvard University, Harvard Institute of Economic Research, 1978), 22.

Evidence of relatively high private rates of return on R & D does not support an argument for greater R & D subsidies or more generous tax treatment of R & D expenditures. Tax expenditures and subsidies should be used to encourage activities that are socially but not privately beneficial. If it is true that the returns on R & D are higher than is generally believed, the appropriate policy is to make this known. If it is the case that the high return on R & D reflects the risks associated with it, there is no role for the government unless the latter can bear these risks at a lower cost than individual R & D performers. Even here the government intervention may take the form of offering a general risk-bearing service rather than measures to encourage R & D per se. The question of whether the government can, in fact, bear risk at a lower cost than individual R & D performers is discussed more fully in McFetridge.[19]

The fourth category of studies includes those that examine the impact of tax, subsidy, and contracting policies on the level of industrial R & D spending. These studies presuppose that the government has the type of information, perhaps inferred from studies similar to those of Mansfield et al.[20] or Nadiri,[21] that has led it to introduce measures intended to encourage R & D spending. Their concern is generally with the amount of government spending (including tax expenditures) necessary to induce a given increase in industrial R & D spending. That is, the concern of this type of study is more with distribution than with resource allocation. Specifically, if the discrepancy between the social and private return on R & D at the margin is known, a subsidy or tax incentive can be introduced to eliminate it. As a result, R & D that is socially beneficial but that would not otherwise have been undertaken is undertaken. It may also be true, however, that these incentives cannot be confined to projects that would otherwise have been privately (but not socially) extramarginal. These incentives may also serve to increase the profitability of R & D that would have been undertaken in any case. In this event the government is spending more than is strictly necessary to achieve a given allocative effect. While this "excess" spending is only a transfer, it does have to be raised, and raising it may entail allocative and political costs that the government wishes to avoid.

Studies in this fourth category are all ultimately concerned with the extent to which various R & D incentives have missed their target and hit activities or projects that are privately intramarginal. These studies have examined subsidies (Howe and McFetridge),[22] contracts (Goldberg, Carmichael)[23] and tax measures (Goldberg, Nadiri).[24] The Howe and McFetridge study found that Canadian R & D subsidies that were intended to cover one-half the cost of additional R & D projects resulted in something less than one dollar of additional private R & D for each dollar of subsidy paid out. The implication is that on average, the subsidies tended to go largely but not entirely to projects that would have been privately extramarginal. The Goldberg and Carmichael studies found that recipients of U.S. federal R & D contracts did not change their own (self-financed) R & D significantly. U.S. government R & D contracts have had the effect of changing *total* R & D spending by the amount of the contract and no more. The same increase in spending could have been achieved if the government had conducted this R & D itself. It should be noted, however, that this result is not unexpected in that there is no reason for a government R & D contract to affect the marginal return on the contractor's own R & D effort.

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[19] See generally, supra footnote 9.

[20] Supra footnote 7.

[21] Supra footnote 14.

Studies of the impact of R & D tax incentives use an approach well known to those who have studied the impact of conventional investment incentives.[25] There are two essential elements in these studies. The first is a summary measure of the tax-inclusive cost of R & D. Ideally this would be the user cost or implicit rental price of R & D capital.[26] In fact, both the Goldberg and Nadiri studies use rough approximations of the user cost.[27] The present study introduces the concept of the B-index, which serves the same purpose as the user cost.

The second element in these studies is an estimate of the elasticity of the demand for industrial R & D with respect to the user cost of it. This elasticity estimate is obtained from a statistical relationship between R & D spending and the costs of R & D and other inputs, which is known as a factor demand function. Given the relationship between the tax system and the user cost of R & D and the relationship between the user cost of R & D and the desired stock of it, the effect of a given tax measure on R & D spending can be determined. Once the relationship has been established between the tax treatment of R & D and the desired R & D spending of firms, the tax expenditure necessary to induce a given amount of R & D spending can be calculated. The question then becomes one of finding the set of incentives that can induce a given additional amount of R & D with the lowest wealth transfer.

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[22] J. D. Howe and D. G. McFetridge, "The Determinants of R & D Expenditures" (February 1976), 9 *Canadian Journal of Economics* 57-71.

[23] Lawrence Goldberg, *The Influence of R & D Funding on the Demand for and Returns to Industrial R & D*, Report no. NSF/PRA 7722919 (Washington, D.C.: National Science Foundation, October 1979); Jeffrey Carmichael, "The Effects of Mission-Oriented Public R & D Spending on Private Industry" (June 1981), 36 *The Journal of Finance* 617-27.

[24] Goldberg, supra footnote 23; Nadiri, supra footnote 14; Nadiri, supra footnote 6.

[25] See J. Douglas May, "Investment Incentives as Part of an Industrial Strategy" (Winter 1979), 5 *Canadian Public Policy* 70-79.

[26] See Robert Eisner, "Tax Policy for Investment: Implications for Innovation," in Eileen L. Collins, ed., *Tax Policy and Investment in Innovation* (Washington, D.C.: National Science Foundation, 1981), c1-c29; Robin Boadway, *Public Sector Economics* (Cambridge, Massachusetts: Winthrop, 1979).

[27] Supra footnote 24.

The ratio of induced R & D to tax revenue forgone depends on the responsiveness of the user cost (or its substitute) to the incentive measure in question and on the response of the desired amount of R & D spending to changes in the user cost. If both responses are small, then the tax system will be a costly method (in the sense of requiring a large wealth transfer to achieve a small allocative effect) of encouraging R & D.

Chapter 8 of this study contains some rough calculations of the effect of the Canadian R & D incentive measures on R & D spending in Canada. These calculations constitute only a crude beginning, however; much more work is required in this area.

The examination of the literature on the economics of R & D indicates that, from a public policy point of view, two segments of this literature are relevant. One segment provides an efficiency rationale for government intervention in the R & D process. It does so by showing that the social return on R & D exceeds either the private return on R & D at the margin or the social return on other types of investment at the margin. The other segment will ultimately facilitate the comparison of alternative forms of intervention. Specifically, it will allow the government to structure its intervention so as to achieve a given allocative effect with the smallest possible transfer of wealth.

It should be emphasized that both these streams of literature are in the very early stages of development. The present study contributes to that development in a number of ways. It derives a summary measure of the impact of the tax system on a firm's return on R & D. This summary measure, the B-index, constitutes an initial step towards the construction of a user cost of R & D . Using the B-index we are able

- to compare current Canadian R & D incentives with those that have existed in the past;
- to demonstrate how the incentive to do R & D varies across firm sizes, regions, and types of activity within Canada;
- to compare Canadian R & D incentives with those that exist elsewhere and thus to draw inferences regarding their relative adequacy;
- to compare the incentives for R & D with the incentives for other types of investment in Canada;
- to compare the difference in the respective incentives for R & D and alternative types of investment with estimates of the excess of the social over the private rate of return on R & D and thus to draw some inferences regarding

the adequacy of R & D incentives from an allocative efficiency point of view; and

- to estimate the extent to which R & D in Canada would decline if it were treated the same for tax purposes as other types of investment (for example, plant and equipment).

2

The Elements of the Tax Environment of R & D

This study examines the following features of the tax systems of 20 countries as they relate to scientific R & D:

- the time period over which both current and capital expenditures on scientific research may be written off against taxable income;
- the existence of any additional deductions from taxable income (allowances) that are based on the level or the change in the level of R & D spending;
- the existence of any tax credits (reductions in taxes payable) that are based on the level or the change in the level of R & D spending;
- the rate at which corporate income is taxed;
- the rate (if it differs) at which corporate technology royalty income is taxed; and
- the existence of provisions for carrying forward operating losses.

A number of features of national tax systems that relate to the R & D decision as well as to other investment decisions are not examined here. The most obvious omission is the cost of finance. International differences in the extent to which financial charges may be deducted against taxable income at the corporate level are not examined, nor are the effects of international differences in the tax treatment of dividends and capital gains nor, for that matter, individual tax rates. Consideration is thus confined to tax measures related specifically to the R & D decision at the corporate level. Perhaps a broader investigation would result in a different ranking of national tax systems insofar as their treatment of investment in general is concerned. That is, it may be that some countries offer no specific incentives for R & D but compensate for this by taxing investment income in general very lightly. The present study would incorrectly rank such a country as having a relatively unfavourable tax environment for R & D. In defence it should be noted, first, that those who advocate more favourable tax treatment of R & D in Canada tend to focus on tax measures relating specifically to R & D rather than on the tax environment as a whole. Second, the greater the number of tax measures considered, the less likely it is that national differences in the net impact of these measures on the R & D decision can be compared.

For those seeking a more detailed examination of a limited number of tax systems, the National Science Foundation has recently published a description of the tax treatment of investment in six western countries including Canada.[1] The NSF makes no attempt to compare the respective impacts of the tax systems examined on the R & D decision.

The tax measures examined here relate directly to the R & D decision. Consider first the effect on the R & D decision of the time period over which R & D expenditures may be deducted from taxable income. In general, the earlier an expenditure may be written off against taxable income, the greater the present value of the deduction, hence of the tax saving involved, and the lower the net-of-tax cost of the R & D. To take a simple example, suppose under one tax regime an expenditure of one dollar on R & D may be deducted from income in the year it is made, while under another regime the expenditure must be capitalized and depreciated at an annual rate of, say, 30 per cent. Under the first regime the present value of the R & D deduction is \$1, the tax saving is \$t (where t is the corporate tax rate), and the net-of-tax cost of the R & D is \$(1−t). Under the second regime, some of the tax savings are postponed. Discounting future tax savings at, say, 15 per cent, the present value of the R & D deduction under the second regime is \$.67. The tax saving is \$.67t and the net-of-tax cost of the R & D is \$(1−.67t), which is higher by \$.33t than under the first regime.

For accounting purposes, R & D expenditures are separated into current expenditures, which would include the wages of research personnel and the cost of materials used, and capital expenditures, which would include the cost of equipment and facilities. All the countries examined in this study allow current expenditures on R & D to be deducted from income in the year they are incurred. These countries do differ, however, in that some allow capital expenditures for R & D purposes to be written off in the year they are incurred, while others require that they be depreciated over their economic life or some fraction thereof. Other things being equal, the net-of-tax cost of R & D will be lower in the countries that allow the immediate write-off of expenditures on R & D facilities and equipment.

While expenditures on wages and salaries of research personnel may be regarded as current expenses for tax purposes, there is a clear case for regarding *all* R & D expenditures as capital expenditures. A number of studies, including those of Schott,[2] and Pakes and Schankerman,[3] have shown that

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[1] National Science Foundation, *Corporation Income Tax Treatment of Investment and Innovation Activities in Six Countries*, PRA Research Report 81-1 (Washington D.C.: National Science Foundation, 1981).

[2] Kerry Schott, "Investment in Private Industrial Research and Development in Britain" (December 1976), 25 *The Journal of Industrial Economics* 81-99.

[3] A. Pakes and M. Schankerman, *The Rate of Obsolescence of Knowledge, Research Gestation Lags, and the Private Rate of Return to Research Resources*, Discussion Paper no. 659 (Cambridge, Massachusetts: Harvard University, Harvard Institute of Economic Research, 1978).

R & D yields a flow of income over time. That is, R & D can be regarded as an intangible capital asset, the value of which decays over time as the technological knowledge involved becomes obsolete. An accountant seeking to report a net income figure that truly reflected the economic fortunes of his firm would capitalize the firm's R & D expenditures and depreciate them at their economic decay rate. The cost of research would then be written off against income over its entire useful life rather than over some part of it.

The tax systems of all countries examined here require that this practice be followed in part, for physical capital used for purposes other than R & D. Physical capital is depreciated over its economic life, although depreciation charges are often accelerated—that is, taken earlier than the decline in the economic value of the assets involved actually warrants. The deductibility of so-called current R & D expenditures in the year they are incurred is equivalent to allowing for an extreme acceleration of depreciation that can be taken on a firm's stock of knowledge. Instead of R & D being written off at 10 per cent per year as the Schott data suggest is appropriate, it is written off immediately.

Since all the countries examined here follow this practice, there is no question of international differences in the after-tax cost of R & D on this account. What does arise, however, is a bias in favour of R & D as opposed to other forms of investment. The magnitude of the bias depends on the rate at which assets other than the firm's stock of knowledge may be depreciated and on the discount rate.

Consider, for example, the case of a firm that has a choice between the expenditure of \$10,000 on R & D and \$10,000 on a new machine. Suppose the two alternatives offer identical income streams. The R & D expenditure may be deducted from taxable income in the current period, implying a tax saving of $\$10{,}000t$ and an after-tax cost of the R & D project of $\$10{,}000(1-t)$. On the other hand, given the two-year accelerated write-off of machinery allowed in Canada, and the "half-year convention" introduced in the November 1981 budget, a firm purchasing a \$10,000 machine could deduct \$2,500 from taxable income in the year of purchase, \$5,000 the following year, and \$2,500 the year after that. If there is a 15 per cent discount rate, the purchase of the machine carries with it a tax saving with a present value of $\$.8738t$, and the after-tax cost of the machinery "project" is $\$10{,}000(1-.8738t)$. The difference in the net-of-tax costs of the two projects is \$1,262, or 13 cents per dollar spent. The net result is that although these two investments are equivalent in before-tax terms they are not equivalent after tax. The R & D investment is treated more favourably and in this example will be chosen over the new machine.

To this point we have argued that the greater the present value of the reduction of taxable income associated with a given R & D expenditure, the lower the after-tax cost of the R & D. A number of countries have special allowances, the effect of which is to allow firms conducting R & D to deduct more from their taxable income than they actually spend on R & D. These special R & D allowances come in two forms. The first simply allows a firm spending $1 on R & D to deduct $\$(1+k)$ (where $k>0$) from its taxable income for the year in which the expenditure occurs. This implies a tax saving of $\$(1+k)t$ and an after-tax cost of R & D of $\$(1-(1+k)t)$. The greater the amount of the special allowance the lower will be the after-tax cost of R & D.

A second type of special allowance is based on the increase in R & D expenditures over some prior base period. In this case, a firm is allowed to deduct both its R & D expenditures and some fraction, w, of the increase, if any, in its R & D expenditures over some base period. For a $1 expenditure that also involves a $1 increase over the base period, there is a tax saving of $\$(1+w)t$ and an after-tax R & D cost of $\$(1-(1+w)t)$.

Special allowances based on increases in nominal R & D spending appear to have been motivated by the desire of governments to relate tax expenditures more closely to changes in behaviour. To illustrate, a special allowance of the first type reduces the after-tax cost of all R & D expenditures, including those that receiving firms would have found profitable and thus undertaken in the absence of the special allowance. As a consequence, the government may be in the position of making a large tax expenditure to achieve a relatively small increase in private R & D expenditures. The limited evidence available on the allocative impact of R & D subsidies and tax incentives is discussed in the preceding chapter.

Special allowances based on increases in R & D expenditures are payments related to changes in behaviour—that is, increases in nominal R & D expenditures. A change in nominal R & D expenditures is, unfortunately, not always indicative of a change in behaviour. Consider a firm that is maintaining a constant real stock of technical knowledge. Maintaining the value of that stock requires an expenditure of $1 annually in real terms. Suppose also that there is a 10 per cent annual rate of inflation. In this case, although real annual R & D expenditures and the real value of the firm's stock of knowledge are both constant, nominal or current dollar R & D expenditures will be rising at 10 per cent per year. If the special allowance is calculated as 50 per cent of the year-to-year increase in nominal R & D spending, this firm will experience an annual tax saving of $\$(.50)(.10)t$. Put another way, firms that maintain a constant R & D-sales ratio, with no real growth in sales but with inflation at an annual rate of $\dot{p}$, will experience a tax saving of $w\dot{p}t$ per constant dollar of R & D (w is the fraction of the year-to-year increase that is deductible).

Although special allowances based on changes in current dollar R & D spending do result in tax savings in the absence of any real change in R & D activity, they also provide an incentive, albeit a small one, to increase real R & D spending. A firm that increases the real value of its stock of technology by \$1 must increase its annual R & D expenditures by \$1 in real terms in order to do so. This once-for-all increase in R & D expenditures will result in a one-time tax saving of \$wt. If invested elsewhere this tax saving could earn \$$r(1-t)wt$ per year, where r is the rate of interest. This simply states in annual terms the value of the one-time tax saving resulting from a \$1 increase in the value of the firm's stock of technology. In essence, the addition of \$1 to the value of the firm's stock of technology qualifies the firm for an annual subsidy of \$$r(1-t)wt$. Given that $r = .15$, $w = .50$ and $t = .50$, the annual subsidy would amount to \$.019.

Tax credits achieve the same effect as special allowances—that is, they reduce the after-tax cost of R & D. Three types of credits are employed by the countries examined in this study. The first type is a reduction of a firm's tax liability equal to some fraction, α, of its annual R & D spending. This credit does not reduce the amount of R & D spending that may be deducted from taxable income. If, for example, R & D were fully deductible, the tax saving on \$1 of R & D spending would be \$$(t+\alpha)$ and the after-tax cost of R & D would be \$$(1-t-\alpha)$. With a 10 per cent tax credit and a 50 per cent tax rate, the tax saving would be \$.60 and the after-tax cost of \$1 of R & D would be \$.40.

A second type of tax credit also involves a reduction of the firm's tax liability by some fraction, α, of its R & D spending but requires that the amount of R & D written off against taxable income be reduced by the amount of the credit. In the terms used above, the tax saving on \$1 in R & D spending would be \$$(\alpha+t(1-\alpha))$. The after-tax cost of R & D would be \$$(1-\alpha)(1-t)$. For the numerical values assumed above, the tax saving would be \$.55 and the after-tax cost of R & D would be \$.45.

The third type of credit is based on the nominal change in a firm's R & D spending over some base period. It may or may not reduce the R & D deductions the firm might otherwise claim. As with the special allowance based on nominal increases in R & D spending, the credit will have two effects. First, in an inflationary environment it will reduce the cost of maintaining a given real stock of knowledge or a given R & D-sales ratio. Assuming that the credit does not reduce other deductions and that the inflation rate is $\dot{p}$, the after-tax cost of each dollar spent maintaining a given real stock of technology is \$$(1-t-\alpha\dot{p})$. Given the numerical values of t and $\dot{p}$ assumed above and a credit, α, of 50 per cent, the after-tax cost of each dollar spent maintaining a given real stock of technology is \$.45. If the deductions that would otherwise be claimed are reduced by the amount of the tax credit, the after-tax cost of each dollar spent maintaining a given real stock of technology is \$$(1-t)(1-\alpha\dot{p})$ or \$.475.

The second effect of a tax credit based on the nominal change in R & D spending is the real effect. That is, the additional R & D spending required to increase the firm's real stock of knowledge by \$1 will qualify for a one-time tax saving of $\$\alpha$ if other deductions are not reduced and of $\$\alpha(1-t)$ if other deductions are reduced by the amount of the credit. In either case there will be an increase in the firm's desired real stock of technology.

The effect of the timing of deductions and of special allowances and credits on the after-tax cost of R & D depends on the corporate tax rate and, perhaps most importantly, on whether the firms involved have any taxable income. In the case of a new firm doing R & D that will yield future income but that is not yielding any current income, neither an immediate write-off nor a special allowance or credit will reduce the after-tax cost of R & D in the manner suggested above.

A firm with current income that is not sufficient to utilize the deductions for which it qualifies faces a number of possibilities. First, it may lose these deductions or credits entirely. This will occur only if R & D *must* be expensed and if there is no provision for carryforward losses. This is not the case in any of the countries examined in this study. Second, insofar as the actual cost of the R & D is concerned, it might be capitalized and depreciated against future income. This preserves some but not all of the potential tax saving associated with these expenditures. Third, it may be possible to carry both R & D expenditures and associated credits or special allowances forward and apply them against taxable income or tax liabilities as they occur. This would appear to involve more flexibility than the capitalization option in that there is no restriction on the amount of the deduction that can be taken in a given future period.

In general, when taxable income is insufficient to allow a firm to make use of the deductions and credits for which it is eligible, the extent to which this increases the after-tax cost of R & D will be smaller

- if deductions may be taken during a tax year of the firm's choosing,
- if carryforward or carryback losses may be created and applied against future or past taxable income, or
- if unused credits or special allowances may be carried forward and applied against future taxable income or tax liabilities.

The option of capitalizing R & D expenses and depreciating them against future income also limits the extent to which the absence of current taxable income increases the after-tax cost of R & D. The capitalization option may be preferable to the creation of carryforward losses if the period over which losses may be carried forward is limited.

The relevance to the R & D decision of the corporate tax rate and the preferential taxation of income such as royalty income that results from R & D activity must be assessed within the context of a somewhat different framework than the one employed in this section. The task of the next section is to develop this alternative framework and to employ it in the discussion of the impact of all the tax measures investigated in this study.

A Summary Measure of the Impact of National Tax Systems on the R & D Decision: The B-Index

The conventional method of measuring differences in the tax treatment of R & D is simply to measure its after-tax cost. This method was adopted in the preceding section and has been employed by other participants in the R & D taxation debate.[4] It carries the unfortunate implication that higher corporate tax rates are beneficial to the corporations paying them. Assuming that an R & D expenditure is a deductible expense, the higher the corporate tax rate, the lower the apparent after-tax cost of R & D. Since it is unlikely that many would regard higher corporate tax rates as an incentive to engage in R & D, or in investment generally, an alternative measure is called for.

The measure adopted here is called the B-index. It is the ratio of the present value of project-related before-tax income to the present value of project-related costs at which an R & D project becomes profitable for the firm that undertakes it. The B-index is thus the critical benefit-cost ratio. Projects with benefit-cost ratios higher than B are profitable for the firm as a whole and are undertaken; projects with benefit-cost ratios less than B are not profitable and are not undertaken.

A firm's R & D opportunities can be regarded as a series of projects each of which will have a benefit-cost ratio. The firm will find it profitable to undertake and, it is assumed, will undertake all projects with benefit-cost ratios in excess of B. Other things being equal, the lower B is, the greater will be the amount of R & D that a firm will undertake. The value of the B-index depends on the tax treatment of R & D. The more favourable its tax treatment of R & D, then the lower a nation's B-index and, other things being equal, the greater the amount of R & D that will be conducted by its corporate residents.

What is the relationship between the tax treatment of R & D and the value of the B-index? In a world in which there are no taxes, the value of the B-index would be 1. A firm would never find it profitable to undertake a project for which the present value of project-related income was less than the present value of project costs. Put another way, no project with a benefit-cost ratio less than 1 would be undertaken. Now let us introduce the tax system with the simplest case, in which R & D expenditures are deductible in the tax year in which they are incurred and corporate income is taxed at rate t, which is set at 50 per cent. There are no additional allowances or credits. The after-tax cost per dollar of R & D expenditure is $1(1-t)$, or \$.50. The present value of the before-tax income required to cover the cost is $.50/(1-t)$, or \$1. The B-index is 1. If R & D expenditures are fully deductible and the income resulting from that R & D is taxed at the same rate as other corporate income, the critical benefit-cost ratio for any R & D project is 1. This is true regardless of the corporate tax rate. In this case, changes in the corporate tax rate do not change the incentive to engage in R & D.

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[4] See, for example, Canadian Chamber of Commerce, "Research Initiatives, A Submission to the Minister of State for Science and Technology" (mimeograph, Canadian Chamber of Commerce, 1980).

On the other hand, if R & D expenditures may not be deducted from taxable income at all, an R & D project must earn $\$1/(1-t)$, or \$2 in present value terms if it is to recover its cost. Here the corporate tax rate is relevant. Projects that would cover their cost with a 25 per cent tax rate (with before-tax earnings of \$1.33) would not do so at a 75 per cent tax rate (where required before-tax earnings are \$4).

More realistically, suppose that the one-dollar R & D expenditure is comprised of \$.80, which is labelled current expenses, and \$.20, which is labelled capital, and that the latter must be depreciated on a straight-line basis over five years. Discounting at 15 per cent, the present value of the depreciation charges on the \$.20 capital component of the R & D is \$.09. The after-tax cost of the R & D is therefore $\$(1-.89t)$, or \$.555. The project must earn $\$.555/(1-t)$, or \$1.11 in present value terms, before tax, to cover its cost. The B-index is 1.11 and is an increasing function of the corporate tax rate. An R & D project that generated income with a present value that covered its cost would be economic in a no-tax world, but would not be economic in a country with the tax environment just described.

Many of the countries examined in this study have B-indexes that are less than 1. This implies that firms are undertaking R & D projects that would not have been undertaken in a no-tax world. Suppose, for example, that firms are allowed to deduct 125 per cent of their R & D costs when these costs are incurred—that is, there is a special allowance equal to 25 per cent of current R & D costs. The after-tax cost of \$1 spent on R & D is $\$1(1-1.25t)$. The B-index is $(1-1.25t)/(1-t)$, or .75.

When allowable deductions exceed expenditures and the "excess" deductions are not taxable, the B-index is a decreasing function of the tax rate. In other words, the lower the tax rate the higher the B-index. A lower tax rate appears to make R & D less rather than more attractive. This is because R & D expenditures are not only fully deductible but also serve to reduce taxes that would have been paid on other income. The lower the corporate tax rate, the smaller the before-tax value of this tax saving. If, for example, a firm is allowed to deduct 125 per cent of R & D costs when these costs are incurred and if the corporate tax rate is reduced from 50 per cent to 40 per cent, the B-index rises from .75 to $(1-1.25(.4))/(1-.4)$, or .83.

It should be noted that a negative relationship between the B-index and the corporate tax rate implies only that a higher tax rate can increase the *relative* attractiveness of R & D expenditures. From the viewpoint of the firm as a whole, deductions that exceed costs (including imputed costs) will also exceed income and will, therefore, be of no value. From the viewpoint of the firm as a whole, then, the B-index must be at least 1, and a higher tax rate is never preferred to a lower one.

The marginal effect of additional deductions or special allowances also depends on the corporate tax rate. It was calculated above that if the corporate tax rate is 50 per cent, a 100 per cent write-off of R & D costs plus a 25 per cent special allowance will result in a B-index of .75. If the corporate tax rate were 25 per cent, the same write-off, special-allowance combination would result in a B-index of .92. In this case the marginal effect of the special allowance on the B-index decreases as the corporate tax rate falls.

Tax credits can also result in a B-index that is less than 1. If a tax credit equal to 10 per cent of R & D expenditures is allowed in addition to a 100 per cent write-off and if the corporate tax rate is 50 per cent, the B-index is $(1-t-.10)/(1-t)$, or .80. Again, the B-index is a decreasing function of the tax rate. If the corporate tax rate were 40 per cent, for example, the B-index would be .83. If, however, the amount of R & D expenditures that may be deducted is reduced by the amount of the credit (the credit is taxable), then the B-index takes on a value of $(1-t)(1-.10)/(1-t)$, or .90 regardless of the corporate tax rate. The lowering of the corporate tax rate reduces the marginal effect of a tax credit on the B-index then, provided that the credit itself is not taxable. If the credit is taxable (deductions allowed are reduced by the amount of the credit), its marginal effect on the B-index will be independent of the corporate tax rate.

Both special allowances and credits that are based on increases in R & D spending over some base year also have the effect of reducing the B-index. The magnitude of this effect depends on how one views the R & D decision. Strain[5] assumes, in effect, that base year spending is zero and then calculates the after-tax cost of R & D for the first year in which positive spending occurs. If the allowance is fraction w of the increase in nominal R & D spending over the base period (which in this example is the previous year) and if there is a 100 per cent write-off but no other credit or allowance, the B-index will be $(1-(1+w)t)/(1-t)$. If w is 50 per cent the B-index is $(1-(1.50)(.50))/(1+.50)$, or .50. The problem with this type of calculation is that it overstates the impact of this type of incentive. In this example, if nominal R & D spending remains constant or decreases the next year, there is no additional deduction at all and the B-index is 1. The problem, then, is to find what is the incentive provided by this once-for-all tax saving that will maintain a given annual level of R & D spending over time.

In order to obtain a more general measure of the impact of this type of incentive on the B-index, we assume and will continue to assume that the firm is choosing an annual level of R & D spending that is profitable to maintain over time. Thus, real annual R & D expenditures are maintained at a level such that the benefit-cost ratio on the last dollar spent annually equals the B-index. The B-index, in turn, is calculated on the assumption that R & D expenditures will be maintained at a constant level in real terms over time. Under these circumstances, allowances or credits based on increases in nominal R & D spending over the previous period will have two effects on the B-index. First, given constant real R & D spending and inflation at an annual rate of $\dot{p}$, nominal R & D spending will rise at a rate of $\dot{p}$ per period and the firm will be entitled to a deduction of $w\dot{p}$ annually. In the absence of other incentive measures and assuming a 100 per cent write-off of R & D expenditures, the B-index is $(1-(1+w\dot{p})t)/(1-t)$. If w is 50 per cent and $\dot{p}$ is 10 per cent, then the B-index is $(1-(1+.05)(.50))/(1-.50)$, or .95. Second, there will be a one-time tax saving of wt for each dollar added to the annual level of R & D spending that the firm decides to maintain. This tax-saving would produce an annual income of $r(1-t)wt$ if invested elsewhere. This is simply the value in annual terms of the once-for-all tax saving associated with an increase of one dollar in the firm's real annual R & D budget. If the rate of interest is 15 per cent, the tax saving involved is $(.15)(1-.50)(.50)(.50)$, or $.019 per dollar added to the annual R & D budget. When both effects of this incentive are included in the calculation, the B-index takes on a value of

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[5] William J. Strain, "Tax and Other Incentives to Reduce R & D Costs," in *Current Developments in Measuring Business Income for Tax Purposes*, Corporate Management Tax Conference 1981 (Toronto: Canadian Tax Foundation, 1982), 227-54, at 251.

$$[1-(1+w(\dot{p}+r(1-t))t)]/(1-t),$$

which is .91. This implies that it will be profitable to maintain real annual R & D spending at a level such that the benefit-cost ratio on the marginal dollar spent each year is .91.

Favourable tax treatment of royalties resulting from past R & D projects can also reduce the B-index. The advantage of R & D in this case stems from the fact that R & D expenses may be deducted from aggregate taxable income, which is taxed at a higher rate than royalty income. Thus, if ordinary income is taxed at rate t_O and royalty income at a lower rate t_R and if ordinary income amounts to a fraction, u, of the total, the firm's average tax rate is

$$T = ut_O + (1-u)t_R.$$

The after-tax cost of R & D is $\$1(1-T)$. If the R & D results in nothing but royalties, the firm's B-index is

$$(1-T)/(1-t_R) = 1-t_R-u(t_O-t_R)/(1-t_R) < 1.$$

The impact of the ability to deduct R & D expenditures whenever income is available, through the use of carryforward losses and the like, cannot readily be illustrated with the B-index or any other summary index. In special cases where the distribution of income over time is known, such calculations can be made. They are not helpful, however, in making the type of general comparisons between countries that are required here.

The Economic Implications of International Differences in the B-Index

The B-index provides a summary measure of international differences in the tax treatment of R & D. As established above, the lower the B-index the lower the benefit-cost ratio at which an R & D project will increase the overall profitability of the firm that undertakes it. Other things being equal, the amount of R & D that will be conducted by a nation's corporate residents varies inversely with its B-index. Since the tax measures that reduce the B-index generally apply only to R & D conducted within the country concerned, as a country's B-index falls, the amount of R & D conducted within that country will increase.

Suppose that country A allows the deduction of current R & D expenses and requires that the capital component be depreciated on a straight-line basis over five years. If 20 per cent of R & D expenditures are of a capital nature and we discount at 15 per cent, the present value of the depreciation charges on the capital component of the R & D is $.09. If the corporate tax rate is 50 per cent, the B-index for country A, B_A, is $(1-.89(.50))/.50$, or 1.11. Country B maintains a 50 per cent tax rate, a 100 per cent write-off of R & D expenditures and a 20 per cent tax credit that does not reduce the deduction that would otherwise be available. The B-index for country B, B_B, is $(1-.50-.20)/.50$, or .60.

The implications of the difference between the respective B-indexes of countries A and B are illustrated in Figure 2.1. The R & D opportunities available to residents of countries A and B are summarized by the MBC or marginal benefit-cost ratio schedule. This is simply the benefit-cost ratio on each additional dollar spent annually on R & D in either country. If the R & D opportunities available to the residents of either country are the same, then the same MBC schedule can be used to determine annual R & D spending in each country. Residents of country A will find it profitable to move along the MBC schedule until their annual R & D spending is $\$OS_A$. At this point the benefit-cost ratio on the last dollar spent (annually) is 1.11, which is also the B-index for country A. R & D spending in excess of OS_A per period would reduce the overall profitability of the corporate residents of A. Residents of country B will find it profitable to move along the MBC schedule until their annual R & D spending is OS_B. At this point the benefit-cost ratio on the last dollar spent each year will be .60. Annual R & D spending in excess of OS_B would decrease the overall profitability of the corporate residents of country B.

In a no-tax world, residents of both A and B would spend $\$OS_p$ annually on R & D. At that level of spending the benefit-cost ratio on the marginal dollar spent each year would be 1. This, of course, is the minimum benefit-cost ratio that R & D can have and still contribute to profitability in a no-tax world. By way of comparison with a no-tax world then, residents of country A will be

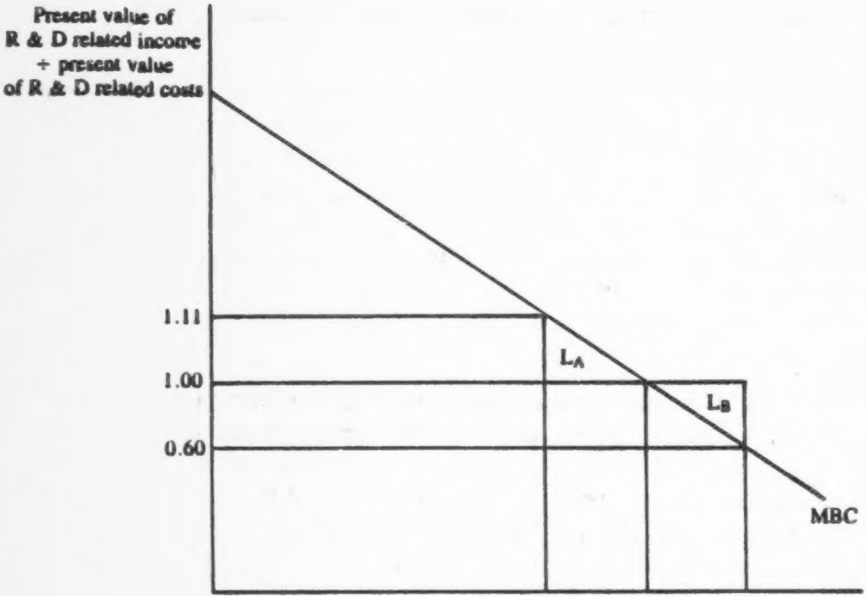

Figure 2.1 The Impact of International Differences in B-Indexes

spending "too little" annually on R & D—they will not be undertaking R & D projects they would undertake if there were no taxes, credits, or allowances. Residents of country B, on the other hand, will be undertaking projects they would have rejected in a no-tax world—they will be undertaking some R & D ($\$S_pS_B$ per year) not because of the income it produces but because of the taxes they will save on other income. While country B spends more each year on R & D than A, neither country is spending the "correct" amount. When compared with the level of R & D spending that would prevail in a no-tax world, residents of A are forgoing surplus in the amount of $\$L_A$ annually, while residents of B are forgoing surplus in the amount of $\$L_B$ annually.

The above discussion has assumed that, while R & D opportunities are similar in A and B, they are specific to each country. An alternative assumption is that the MBC schedule represents the world-wide distribution of R & D opportunities, and that these opportunities can be exploited from within either A or B. In this case, S_AS_B of these opportunities could only be exploited by residents of B. While OS_A could profitably be conducted within A, the tax burden would be higher by $.255 per dollar spent than in B. For this reason, all R & D will be located in B.

In the case just examined, annual R & D spending, all of which takes place in B, will be greater by $\$S_pS_B$ per year than in a no-tax world. Some projects will be undertaken because they reduce the overall tax liability of the firm that

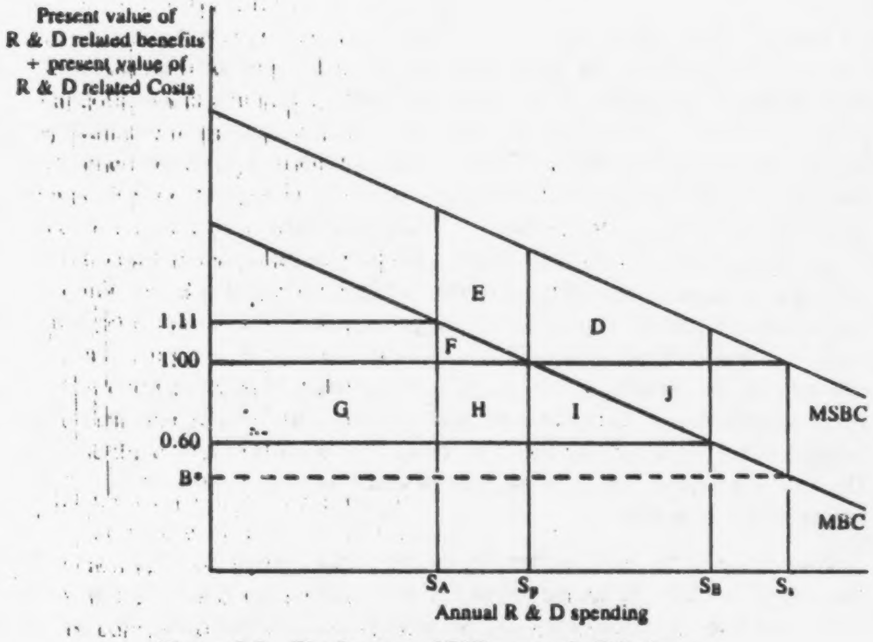

Figure 2.2 The Impact of Differences in B-Indexes When Social and Private Benefits of R & D Differ

undertakes them rather than because of the value of the new technology they expect to develop. The resulting deadweight loss, all of which is borne by residents of B, is given by triangle L_B in Figure 2.1.

Most commentators follow Arrow[8] in asserting that there is a positive externality associated with R & D. That is, R & D confers benefits on individuals for which the latter are not obliged to pay. Put another way, it is costly for inventors to keep others from copying their inventions ("free riding"). To the extent that R & D results in benefits to society in excess of those received by the R & D performer, the social benefit-cost ratio of a given R & D project will exceed the private benefit-cost ratio. Thus there will be a marginal social benefit-cost schedule (MSBC schedule), which lies above the MBC schedule employed in Figure 2.1. The relationship between the two schedules is illustrated in Figure 2.2. The vertical distance between the two schedules represents, for each successive dollar of R & D, the benefits that accrue to someone other than the performer of the R & D.

Dealing first with the case in which R & D opportunities are similar in countries A and B but are specific to each country, we find that, if there are no taxes, privately optimal R & D spending (OS_p) falls short of socially optimal spending (OS_s) in both countries. The reason is that R & D performers do not take into account all the benefits resulting from their R & D when they make their spending decisions. They disregard benefits that they cannot appropriate. Country B's tax policy partially remedies this problem of inappropriability. The R & D incentives offered by B increase R & D spending in that country beyond what it would be in a no-tax world. In Figure 2.2, B's annual R & D spending, OS_B, approaches but is still less than the socially ideal level of spending, OS_s. The additional surplus accruing to residents of B as a result of its R & D inducing tax policy is shown in Figure 2.2 as area D. Country A's tax policy aggravates the problem of inappropriability, reducing R & D spending by its residents below what it would be in a no-tax world. A's tax policy has the effect of moving R & D spending away from, rather than towards, the socially ideal level. As a consequence, residents of A forgo surplus in the amount of E+F per period, which would accrue to them in a no tax world, or D+E+F per period, which would have accrued to them had they adopted B's tax treatment of R & D.

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[8] K. J. Arrow, "Economic Welfare and the Allocation of Resources for Invention," in R. R Nelson, ed., *The Role and Direction of Inventive Activity* (Princeton: Princeton University Press, 1962), 609-25.

Notice that in this example neither country's tax system is sufficiently generous to offset fully the inappropriability of the returns on R & D. Tax policies that reduced the B-index to B* (shown in Figure 2.2) in both countries would result in spending of $\$OS_s$ per year in each country. At this level of spending the social benefit-cost ratio on the marginal dollar of R & D spending is 1, and there is no change in R & D spending that will yield a greater surplus.

Despite the determined efforts of Mansfield et al.,[7] relatively little is known about the magnitude of the inappropriable benefits associated with an additional dollar of R & D spending. Thus there is relatively little evidence against which the allocative effects of observed B-indexes may be judged. An alternative approach is to assume that observed B-indexes reflect the views of the governments involved regarding the magnitude of the inappropriable benefits associated with R & D. In the present example, an observed B-index of .60 implies that the government of B believes that the inappropriable benefit is \$.40 on the marginal dollar spent on R & D. Put another way, a B-index of .60 would result in the "ideal" level of R & D spending in B if the social benefit on the marginal dollar of R & D were 167 per cent of the private benefit. Calculations of this nature will be explored in greater detail in Chapter 7.

Turning now to the case in which R & D opportunities are international, the MSBC and MBC schedules represent the worldwide distribution of R & D opportunities, and $\$OS_B$ will be spent annually on R & D. All of this spending will take place in country B.

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[7] Edwin Mansfield, John Rapoport, Anthony Romeo, Edmond Villani, Samuel Wagner, and Frank Husic, *The Production and Application of New Industrial Technology* (New York: Norton, 1977).

In our example, the B-index in country B is .60. This implies that an R & D project with a private benefit-cost ratio of .60 is profitable for the firm as a whole. If a project with this benefit-cost ratio is regarded as profitable, it must be the case that for every dollar it spends on R & D, the firm involved is receiving \$.40 in the form of a reduction in its overall tax liability. If this is so, 40 per cent of the annual R & D spending in B is, in fact, funded by the government in the form of forgone tax revenue. The tax policy pursued by country B has the effect of providing an annual R & D subsidy in the amount given by areas G+H+I+J in Figure 2.2. Of this, the amount given by areas G+H+I serves only to increase the profitability of firms engaging in R & D, while the amount given by area J serves to increase R & D spending by S_PS_B over what it would be in a no-tax world. Associated with this additional R & D are inappropriable benefits in the amount of D per year, which are bestowed upon the world at large.

To summarize the implications of this simple model, when there is a worldwide pool of R & D opportunities that can be exploited from a base in any country, it will be most profitable to conduct the R & D in the country with the lowest B-index. By forgoing tax revenue, a country such as B in the present example can reduce its B-index and attract this "footloose" R & D. Whether or not this is beneficial to country B is another matter. The tax expenditures in question increase the wealth of the owners of firms performing R & D (by G+H+I per year). These owners may not be residents of B. The same tax expenditures also confer the benefits of additional R & D on the world at large (area D per year). In general, it is more likely to be in the interest of a country to offer incentives that attract footloose R & D if its residents both own a large proportion of R & D performing firms and receive a large fraction of the inappropriable benefits of R & D.

The Components of an Average R & D Dollar

This study has made considerable use of the concept of an average or typical R & D dollar. It found the after-tax cost of the typical or average dollar spent on R & D, which in turn lead to the construction of a B-index—the minimum benefit-cost ratio at which an R & D project is profitable to the firm that undertakes it. The typical R & D dollar can be subdivided into an intramural (spending within the corporate entity) component and an extramural (spending outside the corporate entity) component. The intramural component can also be broken down into current and capital expenditures. Current intramural expenditures can be further subdivided into wages and salaries and other current expenses, while capital expenditures can be broken down into expenditures on buildings and equipment.

The reason that the components of the R & D dollar must be identified is that each of them may be treated differently for tax purposes. It may be that some components are eligible for special R & D incentives while others are

Table 2.1 Intramural Industrial R & D in Canada, 1972-1981

Year	(1) Total manufacturing	R & D by all industrial firms (2) Current	R & D by all industrial firms (3) Capital	(3)/(2+3)
		millions of dollars		
1972	385	412	47	.102
1973	422	460	43	.085
1974	509	537	77	.125
1975	561	631	69	.099
1976	604	687	68	.090
1977	668	786	71	.083
1978	791	887	120	.119
1979	986	1,080	193	.152
1980	1,176	1,301	199	.133
1981	1,510	1,602	293	.155
10-year average				.114

Source: Statistics Canada, *Science Statistics*, September 1981, and May 1982, Catalogue no. 13-003.

not. All of this will vary from country to country. If an accurate comparison of the impact of national tax systems on the cost of R & D is to be made, then the effect of each tax measure or incentive must be weighted by the proportion of the R & D dollar to which it applies. The purpose of this section is to provide the requisite weights.

The most important weight is that of the capital component of R & D expenditures. Most of the countries examined in this study treat current R & D expenditures differently from capital R & D expenditures. Canada is one of the few exceptions in this regard. In most countries, capital assets devoted to R & D must be depreciated. As a consequence, the tax saving on this component of R & D expenditures will be smaller than on the current component. The extent to which this increases the after-tax cost of the typical R & D expenditure depends on the fraction of the expenditure that will normally be classified as capital. The proportion of Canadian industrial R & D expenditures classified as capital is reported in Table 2.1. The average for the 10-year period 1972-1981 was 11.4 per cent. For the OECD countries, the respective proportions of aggregate R & D expenditures that are classified as capital are reported for the year 1977 in Table 2.2. The 14-country average is 10.6 per cent. It can thus be concluded that approximately 10 per cent of the typical R & D dollar is a capital expenditure and is treated as such for purposes of the determination of taxable income.

It is worthwhile to note the consequences of misstating the fraction of R & D expenditures that are capital in nature. If, for example, this fraction has been understated, the after-tax cost of R & D in countries that allow for a comparatively slow write-off of R & D capital will also be understated relative to countries such as Canada that allow a comparatively fast or immediate write-off. If Tables 2.1 and 2.2 are any indication, a capital proportion of 10 per

Table 2.2 The Composition of Intramural R & D Expenditures in OECD Countries, 1977

Country	Labour costs as a % of total R & D cost	Current expenditures as a % of total R & D cost	Capital expenditures as a % of total R & D cost	Expenditures on land and buildings as a % of total R & D cost	Expenditures on instruments and equipment as a % of total R & D cost
Australia (1976/77)	70.2	90.0	10.0	4.2	5.8
Belgium	60.0	90.2	9.8	—	—
Canada	56.0[a]	90.6	9.4	—	—
Denmark	61.2	89.2	10.8	5.9	4.9
Finland	64.1	89.2	10.8	5.4	5.4
France	59.7	91.2	8.8	—	—
Germany	59.9	89.3	10.7	4.1	6.6
Iceland	59.8	88.4	11.6	4.7	6.9
Italy	57.1	88.5	11.5	2.1	9.4
Japan (1977/78)	53.9	84.8	15.2	3.8	11.4
Netherlands	63.8	91.1	8.9	—	—
Norway	57.2	87.5	12.5	6.9	5.5
Sweden (1977/78)	59.9	92.8	7.2	2.8	4.4
Switzerland	57.0	89.1	10.9	—	—
Average	60.0	89.4	10.6	4.4	6.7

[a] Estimated from Statistics Canada, Catalogue no. 13-203, 1973-1975, Table 4.

Source: Organisation of Economic Cooperation and Development, *International Statistical Year, 1975* (Paris: OECD, 1979).

cent understates the capital component of the typical R & D dollar. If this is the case, we will also be understating the after-tax cost advantage of performing R & D in Canada.

Buildings and equipment are generally depreciated at different rates. Buildings are often written off over a longer period than is equipment. Some of the countries examined in this study allow for an accelerated write-off of R & D equipment, some allow for an accelerated write-off of R & D buildings, some allow both, and some allow neither. In order to show the influence on the after-tax cost of R & D of credits, special allowances, and accelerated write-offs of either R & D equipment or buildings, it is necessary to know the weight of expenditures on each class of asset in the R & D dollar.

Very little information is available on the fractions of R & D expenditures devoted to buildings and equipment respectively. What little there is, is reported in Table 2.2. The nine-country average proportion of R & D spent on land and buildings, which are reported together, is 4.4 per cent. The average proportion spent on equipment is 6.7 per cent. Canada is not among the countries for which these data are available. Given the paucity of information in this area, this study has simply taken the 10 per cent of R & D that is said to be allocated to capital and assumed that half of it is spent on buildings (5 per cent of the total) and half on equipment (5 per cent of the total) and that none is spent on land. As will become evident later,[a] these weights could be changed by several percentage points without materially affecting the results.

Table 2.2 also provides an estimate of the labour component of the typical R & D dollar, which is about 60 per cent. This weight will be used to evaluate incentives, offered by countries such as Sweden, that are based on the R & D wage and salary expenditures of the taxpayer.

Some countries treat extramural and intramural R & D expenditures differently for tax purposes. Others, such as Mexico, offer incentives, the values of which depend on the taxpayer's level of domestic extramural R & D spending. The effect of these incentives on the after-tax cost of R & D depends on the weight attached to extramural R & D spending. Weights for Canada are reported in Table 2.3. Domestic extramural R & D accounts for 9 per cent of all domestic R & D and 8 per cent of domestic plus extramural foreign R & D. Extramural foreign R & D accounts for approximately 10 per cent of all domestic plus extramural foreign R & D. These proportions have been used in the few cases in which a weight for extramural R & D is required.

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[a] See Chapter 5 of the text under the heading "The B-Index."

Table 2.3 Payments for Extramural Industrial R & D —Canada, 1970-1979

Year	(1) Extramural domestic	(2) (1)+total domestic	(3) Extramural foreign	(4) (1)÷(3+ total domestic)	(5) (3)÷(3+ total domestic)
			millions of dollars		
1970	30.5	.073	44.5	.066	.097
1971	31.5	.067	51.6	.060	.099
1972	34.6	.075	58.3	.075	.112
1973	47.7	.095	64.0	.084	.113
1974	52.9	.086	80.9	.076	.117
1975	67.9	.094	78.3	.085	.098
1976	72.3	.095	81.0	.086	.096
1977	105.7	.121	103.2	.108	.106
1978	102.1	.101	99.6	.092	.090
1979	100.1	.095	97.5	.087	.085
10-year average		.090		.081	.101

Source: Statistics Canada, *Science Statistics*, August 1979, Catalogue no. 13-003.

3

The R & D Tax Environment in Canada

Evolution of the Tax Treatment of R & D

Under section 72 of the 1952 Income Tax Act[1] and in section 65 of the 1948 Income Tax Act,[2] current expenditures for scientific R & D were wholly deductible in the taxation year in which they occurred. This provision still exists under subsection 37(1) of the 1971 Income Tax Act,[3] where eligible current R & D expenses are defined as

- payments for scientific research related to the business and directly undertaken by or on behalf of the taxpayer;
- payments to an approved association that undertakes scientific research related to the class of business of the taxpayer;
- payments to an approved university, college, research institute, or other similar institution to be used for scientific research related to the class of business of the taxpayer; and
- payments to corporations resident in Canada that are either taxable or tax-exempt, for scientific research related to the business of the taxpayer.

The definition of eligible R & D expenditures implied in the first three items above is the same as that given in subsection 72(1) of the 1952 Act. Provisions for the deduction of payments to nonprofit and to taxable corporations were added to the Act in 1961 and 1963 respectively. Under subsection 37(2) of the 1971 Act, and under paragraph 72(1) (a) of the 1952 Act, payments of a current nature for scientific research carried on outside Canada are also eligible deductions.

Before 1961, one-third of the capital expenditures on scientific R & D made during the tax year and any two preceding years were also deductible in any given tax year. The total deduction for scientific R & D was not to exceed 5 per cent of the previous tax year's taxable income unless the research program under which the expenditures were made had been approved by the

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[1] Income Tax Act, RSC 1952, c. 148.

[2] Income Tax Act, SC 1948, c. 52.

[3] Income Tax Act, SC 1970-71-72, c. 63.

Department of National Revenue. In 1961, the Income Tax Act was amended to allow a 100 per cent write-off of capital R & D expenditures in the taxation year in which they were incurred or in any year thereafter. The deferral privilege was extended to current R & D expenditures in 1974. After 1974, both current and capital R & D expenditures could be written off in the year they were incurred or in any year thereafter.

In 1962, an amendment eliminated the requirement for approval by the taxation authorities of R & D programs involving deductions in excess of 5 per cent of the previous year's taxable income. The same year also brought the introduction of an incentive scheme designed to induce firms to increase their R & D expenditures. Under the scheme, firms were permitted to deduct from taxable income 50 per cent of any increase in R & D expenditures of either a current or a capital nature over their base R & D expenditures. A firm's base R & D expenditure was defined as the aggregate of current and capital R & D expenditures made during the 1961 tax year. If a firm had no tax year in 1961 or before 1961, its base expenditure was regarded as zero.

The 50 per cent deduction for all R & D expenditures in excess of a 1961 base was replaced in 1967 by the Industrial Research and Development Incentives Act (IRDIA).[4] This Act provided for a cash grant or tax credit equal to 25 per cent of the aggregate of

- capital R & D expenditures as defined in subsection 72(1) of the 1952 Income Tax Act and in subsection 37(1) of the 1971 Income Tax Act, and
- current R & D expenditures in excess of the average expenditures made during the base period.

The base period was defined to include the five years preceding the grant year. Where a firm had no tax years or an insufficient number of them to constitute a normal base period, it was deemed to have made no expenditures during the base period. In this case, the grant would be equal to 25 per cent of both current and capital R & D expenditures during the grant year. IRDIA thus provided for a cash grant or tax credit of 25 per cent of any capital expenditure on R & D and 25 per cent of the nominal increase in current R & D spending over a five-year, moving-average base.

This Act remained in force until the end of the 1976-77 fiscal year. After its repeal, the investment tax credit was extended, effective April 1, 1977, to include current and qualified capital expenditures on R & D. Qualified expenditures were those made after March 1, 1977 that complied with subsection 37(1) of the 1971 Income Tax Act. Initially, the credits ranged from 5 to 10 per cent of current and capital R & D expenditures depending on the location of the R & D activity. The 10 per cent credit was granted for R & D performed in the Atlantic provinces and the Gaspé region.

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[4] Industrial Research and Development Incentives Act, RSC 1970, c. I-10.

As of November 17, 1978, credit rates were doubled and an additional credit was added for the benefit of small firms. As a result of these changes, the tax credits available to R & D performers were as follows:

- 25 per cent for a private corporation qualifying for the small business deduction,
- 20 per cent for R & D carried on in the Atlantic provinces and the Gaspé peninsula, and
- 10 per cent for R & D performed elsewhere in Canada.

Since it is only R & D expenditures net of the tax credit that may be deducted from taxable income, a credit of 10 per cent increases taxable income by that amount. With a 46 per cent tax rate on taxable income, the net tax credit would be 10 per cent of (1-46 per cent), or 5.4 per cent.

In 1978, a tax deduction reappeared based on the increase in a taxpayer's R & D expenditures, which allowed taxpayers to deduct from their taxable income 50 per cent of the excess of qualifying current and capital R & D expenditures in the current period over their average R & D expenditures in the preceding three periods. This measure is to remain in force until 1988.

To summarize, the essential features of current Canadian tax treatment of scientific R & D are as follows:

- both current and capital R & D expenditures may be deducted from income in the tax year in which they are incurred or in any subsequent tax year;
- both current and capital R & D expenditures are eligible for a tax credit, which ranges from 10 to 25 per cent, but deductible R & D expenditures are reduced by the amount of the credit; and
- 50 per cent of the excess of the current tax year's R & D expenditures (both current and capital) over the average of the three preceding tax years may be deducted from the current year's taxable income.

In a comparison of Canada with other jurisdictions, several points should be kept in mind. First, the Canadian system offers the taxpayer both the immediate write-off of current and capital R & D expenditures and the freedom to apply any unused deductions in any subsequent period. Second, Canada offers both a tax credit and a special allowance, and both apply to all R & D expenditures rather than to some component (for example, wages or capital expenditures) of them.

In order to measure the value of the incentives currently offered by Canada, let us assume that the R & D decision is one of choosing an annual level of R & D expenditures that will remain constant in real terms over time. This is equivalent to assuming that the taxpayer is maintaining a constant real stock of technology or a constant R & D-sales ratio in the presence of constant real sales.

For the sake of illustration, suppose that the annual rate of inflation is 10 per cent, the rate of interest is 15 per cent, and the tax credit is 10 per cent. With a 10 per cent annual rate of inflation, nominal R & D expenditures will increase at a rate of

$$(1.10)^3-[(1.10)^2+1.10+1]/3 = .23,$$

or 23 per cent annually over a three-year, moving-average base. The taxpayer is entitled to deduct 50 per cent of this increase from his taxable income.

With a 15 per cent rate of interest, the special allowance results in an additional tax saving, the annual value of which is

$$(.46)(.50)(.15)(1-.46) = \$.019$$

for every dollar added to the taxpayer's R & D budget.

With these assumptions plus the immediate write-off of all R & D expenditures and a 46 per cent corporate tax rate, the after-tax cost of the marginal dollar of R & D will be

$$\$[1-.46-.46(.50)(.23)-.46(.50)(.15)(1-.46)-.10(1-.46)] = \$.414$$

and the B-index will be .767. Thus, any R & D project with a benefit-cost ratio in excess of .767 will increase the profitability of the firm that undertakes it. If the R & D were conducted in the Atlantic provinces, its after-tax cost would be

$$\$[1-.46-(.46)(.50)(.23)-(.46)(.50)(.15)(1-.46)-.20(1-.46)] = \$.36.$$

The B-index would be .667.

The After Tax Cost of R & D and the B-Index.

Canada Over Time

The evolution of the tax treatment of R & D in Canada has resulted in successive reductions both in the after-tax cost of R & D and in the B-index. These reductions have come about principally because of the provision introduced in 1961 for an immediate write-off of capital expenditures for R & D and because of the introduction of a series of special allowances and tax credits, the first of which appeared in 1962. Other measures, such as the introduction of a generalized deferral privilege for both current and capital R & D expenditures, have had the effect of reducing the after-tax cost of R & D for firms that might not otherwise have been able to utilize all their deductions.

To illustrate the effect of the changes in the tax treatment of R & D in Canada that have occurred over the last 30 years, both the after-tax cost of the one-dollar R & D expenditure and the B-index are calculated for four time periods. The first is the period 1952-1960, which was characterized by the immediate deduction of current R & D expenditures, the depreciation of capital R & D expenditures at 33 $^1/_3$ per cent per year (straight-line), and no special allowances or credits. The second period, 1962-1966, was characterized by the immediate write-off of both current and capital R & D expenditures and by a special allowance effectively equal to 50 per cent of the difference between the current plus capital R & D spending of any year over that of the previous year. During the third period, 1967-1977, both current and capital R & D expenditures were again eligible for an immediate write-off and, in addition, capital investment was eligible for a 25 per cent nontaxable credit or grant. A credit or grant of 25 per cent of the increase in current R & D expenses over the average of the previous five years was also available. The fourth period runs from 1978 to the present. Both current and capital R & D expenditures may be written off immediately. There is a 10 per cent, taxable tax credit for both current and capital R & D expenditures and there is an allowance equal to 50 per cent of the excess of current and capital R & D expenditures over the average of the previous three years. At present, R & D conducted in the Atlantic provinces and in the Gaspé is eligible for a 20 per cent tax credit. R & D conducted by firms eligible for the small-business tax rate qualifies for a 25 per cent tax credit. (The impact of this difference in tax credits is discussed in the following section where the after-tax cost of R & D is calculated, along with the B-index, for firms that qualify for either the 20 or the 25 per cent credit.)

Calculations are made under the following set of assumptions:

- capital expenditures constitute 10 per cent of the R & D dollar;
- during the period 1952-1960, the present value of the capital cost allowance on a one-dollar R & D capital expenditure was $\$(1/3)(1+(1/(1+r)) + 1/(1+r)^2)$, where r represents the rate of interest and also the discount rate;
- the discount rate is either 10 or 15 per cent;
- the rate of inflation is either 5 or 10 per cent;
- the firms involved maintain constant real R & D expenditures; and
- the corporate tax rate is set initially at 46 per cent, which is the current top rate.

The discount rate assumed affects the after-tax cost of R & D and the B-index only in the case of the period 1952-1960. It was only during this period that deductions were spread over time. Similarly, the inflation rate assumed affects the after-tax cost of R & D and the B-index only when there is an allowance or credit, the value of which depends on the change in nominal R & D spending. The rate of inflation assumed is therefore relevant to calculations made for the periods 1962-1966, 1967-1976, and 1978-1982.

As Table 3.1 indicates, both the after-tax cost of R & D and the B-index are lower for 1962-1966 than for 1952-1960, and lower for 1967-1976 than for 1962-1966. The difference between 1967-1976 and 1978-1982 depends on the rate of inflation assumed. These two periods differ in two essential respects. First, the IRDIA credit of 25 per cent of capital expenditures for

Table 3.1 The After-Tax Cost of R & D and the B-Index—Canada, 1952-1981
(Assuming constant 46 per cent corporate tax rate)

Period	Assumptions	After-tax cost per dollar of R & D	B
1) 1952-1960	$\dot{p} = .05, r = .10$	.548	1.007
2) 1952-1960	$\dot{p} = .10, r = .15$	.551	1.010
3) 1961-1966	$\dot{p} = .05, r = .10$	.517	0.956
4) 1961-1966	$\dot{p} = .10, r = .15$	.498	0.922
5) 1967-1976	$\dot{p} = .05, r = .10$	.463	0.857
6) 1967-1976	$\dot{p} = .10, r = .15$	.407	0.753
7) 1978-1982	$\dot{p} = .05, r = .10$	.449	0.831
8) 1978-1982	$\dot{p} = .10, r = .15$	.414	0.767

Notes: the calculations for each line follow.

Line 1: $B = 1(1-(.46)(.9)-(.46)(.1)(.91))/(1-.46)$.

Line 2: $B = 1(1-(.46)(.9)-(.46)(.1)(.88))/(1-.46)$.

Line 3: $B = 1(1-.46-(.46)(.5)(.05)-(.46)(.5)(.10)(1-.46))/(1-.46)$.

Line 4: $B = 1(1-.46-(.46)(.5)(.10)-(.46)(.5)(.15)(1-.46))/(1-.46)$.

Line 5: $B = 1(1-.46-(.25)(.1)-(.25)(.9)(.17)-(.25)(.10)(1-.46))/(1-.46)$.

Line 6: $B = 1(1-.46-(.25)(.1)-(.25)(.9)(.39)-(.25)(.15)(1-.46))/(1-.46)$.

Line 7: $B = 1(1-.46-(.46)(.5)(.11)-(.46)(.5)(.10)(1-.46)-.10(1-.46))/(1-.46)$.

Line 8: $B = 1(1-.46-(.46)(.5)(.23)-(.46)(.5)(.15)(1-.46)-.10(1-.46))/(1-.46)$.

R & D is replaced by a taxable 10 per cent credit that applies to *all* R & D. This increases the tax-saving on a typical R & D dollar by $[(.10)(1-.46) - (.25)(.10)]$, or \$.029. The reason is, of course, that the IRDIA credit applied only to the capital portion of the R & D dollar.

Second, the IRDIA credit of 25 per cent of the excess of *current* R & D spending in the present period over the average of the previous *five* years is replaced by an allowance equal to 50 per cent of the excess of *current plus capital* R & D spending in the current period over the average of the previous *three* years. Given a steady rate of inflation, the apparent increase in R & D will always be greater under the 1967-1976 system than under the 1978-1982 system. The greater the rate of inflation, the greater this difference will be. At a 10 per cent rate of inflation, the difference is sufficient to result in a very small increase in the after-tax cost of R & D (lines 6 and 8, Table 3.1). At rates of inflation just below 10 per cent, the 1978-1982 measures result in a lower after-tax cost of R & D and B-index than the 1967-1976 measures (lines 5 and 7, Table 3.1, illustrate this for a 5 per cent inflation rate).

The calculations reported in Table 3.1 assume a constant corporate tax rate of 46 per cent in order to isolate the effects of the changes in R & D incentives that have occurred over time. The top rate of corporate income tax has, however, changed over the period in question and this will have some impact on

Table 3.2 The After-Tax Cost of R & D and the B-Index with Variable Corporate Tax Rates—Canada, 1952-1982

Period	Corporate income tax, per cent	Assumptions	After-tax cost per dollar of R & D	B
1) 1952-1960 (excluding 1958)	50	$p=.05$, $r=.10$	0.504	1.008
2) 1952-1960 (excluding 1958)	50	$p=.10$, $r=.15$	0.506	1.012
3) 1958	47	$p=.05$, $r=.10$	0.534	1.008
4) 1958	47	$p=.10$, $r=.15$	0.566	1.011
5) 1961-1966	50	$p=.05$, $r=.10$	0.475	0.950
6) 1961-1966	50	$p=.10$, $r=.15$	0.456	0.912
7) 1967-1972	50	$p=.05$, $r=.10$	0.424	0.848
8) 1967-1972	50	$p=.10$, $r=.15$	0.368	0.736
9) 1973	49	$p=.05$, $r=.10$	0.434	0.851
10) 1973	49	$p=.10$, $r=.15$	0.378	0.741
11) 1974	48	$p=.05$, $r=.10$	0.444	0.854
12) 1974	48	$p=.10$, $r=.15$	0.387	0.744
13) 1975	47	$p=.05$, $r=.10$	0.454	0.567
14) 1975	47	$p=.10$, $r=.15$	0.397	0.749
15) 1976	46	$p=.05$, $r=.10$	0.463	0.857
16) 1976	46	$p=.10$, $r=.15$	0.407	0.753
17) 1978-1982	46	$p=.05$, $r=.10$	0.449	0.831
18) 1978-1982	46	$p=.10$, $r=.15$	0.414	0.767

Notes: the calculations for each line follow.

Line 1: $B = 1(1-(.50)(.90)-(.50)(.10)(.91))/(1-.50)$.

Line 2: $B = 1(1-(.50)(.90)-(.50)(.10)(.88))/(1-.50)$.

Line 3: $B = 1(1-(.47)(.90)-(.47)(.10)(.91))/(1-.47)$.

Line 4: $B = 1(1-(.47)(.90)-(.47)(.10)(.88))/(1-.47)$.

Line 5: $B = 1(1-.50-(.50)(.50)(.05)-(.50)(.50)(.10)(1-.50))/(1-.50)$.

Line 6: $B = 1(1-.50-(.50)(.50)(.10)-(.50)(.50)(.15)(1-.50))/(1-.50)$.

Line 7: $B = 1(1-.50-(.25)(.10)-(.25)(.90)(.17)-(.25)(.10)(1-.50))/(1-.50)$.

Line 8: $B = 1(1-.50-(.25)(.10)-(.25)(.90)(.39)-(.25)(.15)(1-.50))/(1-.50)$.

Line 9: $B = 1(1-.49-(.25)(.10)-(.25)(.90)(.17)-(.25)(.10)(1-.49))/(1-.49)$.

Line 10: $B = 1(1-.49-(.25)(.10)-(.25)(.90)(.39)-(.25)(.15)(1-.49))/(1-.49)$.

Line 11: $B = 1(1-.48-(.25)(.10)-(.25)(.90)(.17)-(.25)(.10)(1-.48))/(1-.48)$.

Line 12: $B = 1(1-.48-(.25)(.10)-(.25)(.90)(.39)-(.25)(.15)(1-.48))/(1-.48)$.

Line 13: $B = 1(1-.47-(.25)(.10)-(.25)(.90)(.17)-(.25)(.10)(1-.47))/(1-.47)$.

Line 14: $B = 1(1-.47-(.25)(.10)-(.25)(.90)(.39)-(.25)(.15)(1-.47))/(1-.47)$.

Line 15: $B = 1(1-.46-(.25)(.10)-(.25)(.90)(.17)-(.25)(.10)(1-.46))/(1-.46)$.

Line 16: $B = 1(1-.46-(.25)(.10)-(.25)(.90)(.39)-(.25)(.15)(1-.46))/(1-.46)$.

Line 17: $B = 1(1-.46-(.46)(.50)(.11)-(.46)(.50)(.10)(1-.46)-.10(1-.46))/(1-.46)$.

Line 18: $B = 1(1-.46-(.46)(.50)(.23)-(.46)(.50)(.15)(1-.46)-.10(1-.46))/(1-.46)$.

Sources: *Canadian Master Tax Guide*, 1965-1981 issues (Toronto: CCH Canadian); Income Tax Act, RSC 1952, c. 148, subsection 39(1), as amended; Income Tax Act, SC 1957-58, c. 17, subsection 4(1); and Income Tax Act, SC 1959, c. 45, subsection 13(1).

the way in which both the after-tax cost of R & D and the B-index have changed over time. The after-tax cost of R & D and the B-index calculated with the top corporate tax rates that actually prevailed between 1952 and 1982 are reported in Table 3.2. With the exception of 1958 when it was 47 per cent, the top corporate rate remained at 50 per cent from 1952 to 1972. Beginning in 1973, it was reduced by a percentage point a year, reaching 46 per cent in 1976 where it remained thereafter.

Incorporation of the observed top corporate tax rate into our calculations leaves the after-tax cost of R & D and the B-index substantially unaltered. The B-index for the period 1952-1960 is slightly higher, while the B-index for the period 1961-1975 is slightly lower than was the case with a constant 46 per cent tax rate. As a consequence, the treatment of R & D during the period 1952-1960 appears somewhat less generous and the treatment of R & D during the period 1961-1975 somewhat more generous relative to the present regime than was the case when a constant 46 per cent tax rate was assumed.

Canada by Region, Firm Size, and Type of R & D Activity

At present, Canadian tax treatment of R & D differs from taxpayer to taxpayer and these differences depend on: (1) the region of the country in which the R & D is conducted, (2) whether the R & D is conducted inside or outside Canada, (3) the size of the firm conducting the R & D, and (4) the line of business (manufacturing and processing, or other) in which the firm conducting the R & D is engaged.

The B-index and thus the acceptability of an R & D project to the firm contemplating it depends on the characteristics of that firm. Thus a firm of one type or size or in one location may undertake R & D that a firm of another type or size or in another location would reject. If, by virtue of its location or size or type of activity, a firm is undertaking R & D it would otherwise reject, the tax system may be misallocating resources. That is, too little R & D may be undertaken in some locations or in some types or sizes of firms and too much in others. It is not certain, however, that this type of discriminatory tax treatment misallocates R & D resources. The differences in the tax treatment of the R & D expenditures of two firms may have been intended to offset differences in the magnitudes of inappropriable (external) benefits associated with the R & D activities of the two firms.

Consider first the impact of differences in the location of R & D on its after-tax cost and the B-index. R & D conducted in the Atlantic region is eligible for a 20 per cent (taxable) tax credit. With a 10 per cent annual rate of inflation and a 46 per cent corporate tax rate, this implies an after-tax cost per dollar of R & D in the Atlantic region of $.36 as compared with $.414 in the rest of Canada, resulting in a B-index of .667. This compares with a B-index for

Table 3.3 The After-Tax Cost of R & D and the B-Index by Characteristics of Firm and R & D, 1981

Firm and R & D characteristics	After-tax cost	B
1) Large, non-Atlantic region, nonmanufacturing, domestic R & D $p=.10$, $r=.15$	0.414	0.767
2) Large, Atlantic region, nonmanufacturing, domestic R & D $p=.10$, $r=.15$	0.360	0.667
3) Small, nonmanufacturing, any region, domestic R & D $p=.10$, $r=.15$	0.519	0.692
4) Small, manufacturing, any region, domestic R & D $p=.10$, $r=.15$	0.565	0.706
5) Large, manufacturing, non-Atlantic region, domestic R & D $p=.10$, $r=.15$	0.476	0.793
6) Large, manufacturing, non-Atlantic region, foreign R & D $p=.10$, $r=.15$	0.614	1.023

Notes: the calculations for each line follow.

Line 1: $B = (1-.46-(.46)(.5)(.23)-(.46)(.5)(.15)(1-.46)-.10(1-.46))/(1-.46)$.

Line 2: $B = (1-.46-(.46)(.5)(.23)-(.46)(.5)(.15)(1-.46)-.20(1-.46))/(1-.46)$.

Line 3: $B = (1-.25-(.25)(.5)(.23)-(.25)(.5)(.15)(1-.25)-.25(1-.25))/(1-.25)$.

Line 4: $B = (1-.20-(.20)(.5)(.23)-(.20)(.5)(.15)(1-.20)-.25(1-.20))/(1-.20)$.

Line 5: $B = (1-.40-(.40)(.5)(.23)-(.40)(.5)(.15)(1-.40)-.10(1-.40))/(1-.40)$.

Line 6: $B = (1-(.90)(.40)-(.40)(.047)-(.40)(.018))/(1-.40)$.

Canada of .767 under the same assumptions (see Table 3.3) and implies that an R & D project with a benefit-cost ratio between .67 and .77 would be undertaken in the Atlantic region but not elsewhere in Canada.

This outcome represents a misallocation of resources unless either a smaller fraction of the benefit of R & D carried out in the Atlantic region is appropriable or the opportunity cost of the resources required for R & D is lower in relation to their market price in the Atlantic region that in the rest of Canada. The first possibility is remote unless R & D in the Atlantic region is specifically applicable to that region and unless it has characteristics that make it more costly to exclude nonpaying users than is the case with R & D conducted elsewhere. The second possibility is somewhat more likely. The existing tax credit differential would, for example, just correct a situation in which the opportunity cost of research workers in the Atlantic region was 87 per cent (.667/.767) of their actual wages while the opportunity cost of research workers elsewhere in Canada was just equal to their wages.

Consider now the differences in the tax treatment of the R & D expenditures of small and large businesses. Small businesses are defined here as those that are eligible for the small business tax rate of 25 per cent. Until the November 1981 budget, the small business tax rate applied only on the first $150,000 of taxable income, and eligibility for it was confined to Canadian-controlled corporations with retained earnings (cumulative deduction account) of less than $750,000. The November 1981 budget proposed that the small business tax rate apply to the first $200,000 of taxable income and that eligibility be confined to Canadian-controlled corporations with retained earnings of less than $1 million.

For the purpose of the construction of B-indexes, our representative small business will have a marginal tax rate of 25 per cent (taxable income less than $200,000) and our large business will not be eligible for the small business rate. The two businesses will also differ in that a business that is eligible for the small business tax rate is also eligible for a 25 per cent investment tax credit on R & D instead of the usual 10 per cent.

Assuming a 10 per cent rate of inflation and constant real R & D spending, the after-tax cost per dollar of R & D for the small business is $.519 (see Table 3.3) as opposed to $.414 for the large business. This simply reflects the fact that the lower the tax rate, the smaller the amount of the deduction from taxable income resulting from a given expenditure. It does not imply that the small business is treated less generously by the tax system. The B-index for the small business is .692 as opposed to .767 for the large business, and it correctly reflects the preferential tax treatment accorded small business R & D expenditures. It implies that R & D projects with benefit-cost ratios between .69 and .77 would be undertaken by a small business but not by a large, non-Atlantic-region business.

Again there are two interpretations of this outcome. The first is that the preferential tax treatment of small business R & D may misallocate resources. For tax reasons, small businesses embrace R & D opportunities that would be rejected by larger businesses. As a consequence, "too much" R & D is done by small businesses and "too little" by larger businesses. A second possibility is that the higher small-business R & D tax credit is intended to offset some other distortion in the economy that would otherwise lead small businesses to engage in "too little" R & D. It is not clear what this distortion might be. The usual answer is that small businesses are the victims of capital market distortions, but there is little evidence that this is so.

It may be that the intention was to assist new technology-oriented businesses, which just happen to be small because they are new. We note that, whatever validity that goal might have (and it is debatable), a tax credit might not be the appropriate means of achieving it. The new technology-oriented business may have no taxable income, in which case the tax credit will have to be carried forward and its value discounted. If, for example, both the tax credit and all deductions and special allowances must be carried forward for three years before they can be used and if the discount rate is 15 per cent, the small-business after-tax cost of a one-dollar R & D expenditure becomes .636 and its B-index .85. The latter is greater than that of a large, non-Atlantic firm. The postponement of the special allowance and of the credit has resulted in the elimination of any advantage to the small business.

This finding raises another possibility regarding the motivation (and allocative efficiency) of the higher R & D tax credits both for small businesses and for the Atlantic region. These businesses may have to wait longer to use their credits because they have less taxable income than other businesses, and so the larger credit may just offset the effect of this waiting period on the after-tax cost of R & D. That is, these credits do not differ in order to offset some distortion. Their nominal values differ so that their *present* values will be the same. If it can be shown that small businesses and Atlantic-region businesses are more likely to have to postpone the use of a tax credit, then differential credits are necessary if the credit scheme as a whole is to avoid distorting the allocation of R & D resources across regions and business size-classes.

The value of R & D incentives also depends on the type of business in which a firm is engaged. Specifically, the top corporate tax rate for firms engaged in manufacturing or processing in Canada is 40 per cent rather than the 46 per cent that applies to corporations engaged in other activities. This difference in tax rates affects both the after-tax cost of R & D and the B-index. As is indicated in Table 3.3, the lower corporate tax rate has the effect of increasing the B-index. Assuming a constant real level of R & D spending and a 10 per cent annual rate of inflation, the B-index for a non-Atlantic-region corporation engaged entirely in manufacturing in Canada is .793. This compares with a B-index of .767 for a corporation that differs only in that it is not engaged in manufacturing or processing.

These results imply that the tax system leads a manufacturing firm to reject R & D opportunities that would be taken by a service or a mining firm.[5] When an R & D expenditure leads to a reduction in taxable income that is greater than the expenditure itself, then the higher the tax rate, the more that excess deduction is worth in terms of before-tax income. Put another way, when the B-index is less than 1, a reduction in the corporate tax rate will increase it. The result is that the Canadian tax system involves a slight bias against R & D in the manufacturing sector as opposed to the service, extractive, and other sectors. The bias is sufficiently small (two percentage points on the B-index) that its practical consequences can be regarded as nil.

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[5] See a discussion of the reasons for this in Chapter 2 of the text under the heading "A Summary Measure . . . the B-Index."

Brief consideration should be given to two other ways in which the tax system may distort R & D decisions. First, it may influence the choice between intramural and extramural (contract) R & D. This would occur if payments to other firms and institutions for R & D services were not eligible for the same deductions, allowances, and credits as intramural R & D. Payments for extramural R & D in Canada are eligible for the investment tax credit and the additional allowance for scientific research.[6] Payments for extramural R & D conducted in Canada are also eligible for an immediate 100 per cent write-off, provided these payments are used by the recipient for expenditures that are current in nature. Thus payments of a capital nature for extramural R & D must be depreciated rather than written off immediately. As a consequence, the B-index for extramural Canadian R & D will be higher than for intramural Canadian R & D.

Strain[7] has observed that it is difficult for a taxpayer to determine precisely what his extramural R & D payments have been used for and that, insofar as payments to nonprofit institutions and unrelated corporations are concerned, Revenue Canada is likely to accept all extramural payments as current without too much question. In this case, the B-indexes for extramural and intramural Canadian R & D will be the same. The distortion of the contracting-out decision is therefore confined to cases in which the extramural R & D would have been conducted by a related corporation.

Second, the tax system may influence the choice between doing R & D domestically and doing it abroad. It is clear that the Canadian tax system does have this impact. R & D done outside Canada by a Canadian corporation is not eligible for the 100 per cent write-off of capital expenditures or for the R & D tax credit or the additional allowance.[8] The B-index for R & D conducted abroad will exceed 1 and will be well in excess of the B-index for R & D undertaken domestically. As least as far as the Canadian tax system is concerned then, there is a strong bias in favour of conducting R & D domestically.

The calculation of a B-index for foreign R & D expenditures by a Canadian corporation is somewhat more complex than for domestic R & D expenditures because the capital component of foreign R & D expenditures must be depreciated rather than expensed. As a result, the present value of the deduction for capital R & D expenditures is something less than the expenditure itself. The actual value of the depreciation or capital cost allowance is given by expression (1) in the following section if the straight-line depreciation method is used and by expression (2) in Chapter 5 if the declining balance method is used.[9]

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[6] *Canadian Master Tax Guide 1981* (Don Mills, Ontario: CCH Canadian, 1980), 186-89.

[7] William J. Strain, "Tax and Other Incentives to Reduce R & D Costs," in *Current Developments in Measuring Income for Tax Purposes*, Corporate Management Tax Conference 1981 (Toronto: Canadian Tax Foundation, 1982), 227-54, at 235-236.

[8] Supra footnote 6, at 187.

If we make the following assumptions:

- a typical R & D dollar is 5 per cent machinery and equipment and 5 per cent buildings and structures,[10]
- machinery and equipment are depreciated over two years using the straight-line method,
- buildings and structures are depreciated over 20 years using the straight-line method,
- the discount rate is 15 per cent, and
- the inflation rate is 10 per cent,

then the present value of the capital cost allowance on the machinery and equipment required for a one-dollar R & D expenditure will be

$$(.05)(.50)(1-(1/1.15)^2)(1.15/.15) = \$.047,$$

the present value of the capital cost allowance on the buildings and structures required for a one-dollar R & D expenditure will be

$$(.05)(.05)(1-(1/1.15)^{20})(1.15/.15) = \$.018, \text{ and}$$

the B-index for a firm engaged in manufacturing and processing will be

$$[1-(.40)(.90)-(.40)(.047)-(.40)(.018)]/(1-.40) = 1.023.$$

This compares with a B-index of .793 on domestic R & D.

The Impact of the Tax System on the Choice Between R & D and Physical Capital

B-indexes for R & D, such as those we have just calculated, represent the minimum benefit-cost ratio at which an R & D project is profitable to the firm as a whole. Because of the incentives for R & D, it is generally profitable even when the present value of the income it generates is less than its cost. This is not true of investments in physical capital. As will be demonstrated, the B-index for a representative investment in new plant and machinery is generally greater than 1. That is, investments in plant and equipment will generally not be profitable for the firm as a whole unless the present value of the before-tax income they generate exceeds their cost. As a consequence, we may observe a firm rejecting an investment in plant and equipment in favour of R & D, even though the former has a higher benefit-cost ratio than the latter.

To demonstrate this proposition it is necessary to calculate the B-index on a representative investment in plant and equipment. It is assumed that this investment is composed of 70 per cent machinery and equipment and 30 per cent buildings and structures, which is approximately the composition of the capital stock of the manufacturing sector as a whole.[11]

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[9] See Chapter 5 under the heading "The B-Index."

[10] See Chapter 2 under the heading "The Components of an Average R & D Dollar."

Neither plant nor equipment may be written off immediately in contrast with all R & D expenditures; both must be depreciated. In the case of a manufacturing firm, machinery and equipment may be written off over two years on a straight-line basis.[12] Buildings and structures may be written off on a straight-line basis at between 5 and 10 per cent per year.[13] Since depreciation allowances are stretched out into the future, their present value will be less than the original expenditure. In the case of straight-line depreciation the present value of the capital cost allowance on a one-dollar expenditure is

$$ZS = 1/T(1-(1/(1+r))^{T})(1+r)/r, \qquad (1)$$

where T is the number of years over which the asset is to be written off, and r is the discount rate or rate of interest. This expression implies that the longer the period over which an expenditure must be written off, and the higher the discount rate, the smaller will be the present value of the allowed deduction.

For purposes of our representative alternative investment, T is 2 for machinery and equipment and 20 for buildings and structures. The discount rate is assumed to be 15 per cent. Under these circumstances, the present value of the capital cost allowance on a one-dollar expenditure on machinery and equipment is $.935, and on buildings and structures is $.360.

Investments in plant and equipment are eligible for a 20 per cent tax credit in the Atlantic region, 10 per cent in the so-called designated areas, which cover most of the rest of Canada outside a few major urban centres, and 7 per cent in those major urban centres.[14] The corporate tax rate for a large firm engaged solely in manufacturing and/or processing is 40 per cent.

The B-index for an investment in plant and equipment that is made outside the Atlantic region but within a designated area by a firm engaged solely in manufacturing or processing is

$$B = (1-(.70)(.40)(.935)-(.30)(.40)(.360)-.10(1-.40))/(1-.40) = 1.06.$$

It was reported in the preceding section that the B-index for a domestic R & D expenditure by a large, non-Atlantic-region manufacturing firm is .793. This implies that a firm with these characteristics would undertake an R & D project with a benefit-cost ratio between .79 and 1.06, while rejecting an investment in plant and equipment with a benefit-cost ratio in the same range. This outcome can be regarded as a misallocation of resources. Investments in physical capital are being rejected solely for tax reasons in favour of investments in R & D capital that have lower benefit-cost ratios.

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[11] Statistics Canada, *Fixed Capital Flows and Stocks*, Table V, Catalogue no. 13-211.

[12] Supra footnote 6, at paragraph 4222.

[13] Ibid., at paragraph 4040.

[14] Ibid., at paragraph 9077.

It might also be argued that the R & D incentives are designed to offset distortions elsewhere in the economy and that without these incentives there would be too little R & D relative to other types of investment activity. That is, while the private benefit-cost ratios on R & D and physical capital may not be equal, the social benefit-cost ratios are. One distortion for which R & D incentives might be compensating is the relative inappropriability of the returns on R & D. It is relatively easy to prevent others from using your plant and machinery without paying for it. It is much more costly to prevent others from using your new technology without paying for it. The question of whether the Canadian R & D incentives are sufficient to offset differences in the appropriability of returns on R & D and on physical capital is addressed in detail in Chapter 7.

Another distortion that the R & D incentives might be designed to offset arises from what many consider to be the high risks associated with R & D. Specifically, if R & D is especially risky and if risk-bearing is a private but not a social cost, then in the absence of special R & D incentives, the private benefit-cost ratio in a given R & D project would lie below the social benefit-cost ratio. As a consequence, some R & D projects that would be socially beneficial would not be undertaken. The question of whether risk-bearing is a cost to individual firms but not to society as a whole has been the subject of a long and inconclusive debate, some of which has been summarized in McFetridge.[15] It is not pursued here except for the comment that the riskiness of R & D is another reason why the discrepancy between the respective B-indexes for R & D and for physical capital might not result in a misallocation of investment resources.

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[15] D. G. McFetridge, *Government Support of Scientific Research and Development: An Economic Analysis*, Ontario Economic Council Research Studies 8 (Toronto: published for the Ontario Economic Council by University of Toronto Press, 1977).

4

The R & D Tax Environment in Other Countries

Major Industrial Countries

The United States

Since 1954, U.S. income tax law has explicitly permitted a taxpayer to deduct current research and experimental expenses from taxable income in the year in which they are incurred.[1] Alternatively, a taxpayer may elect to treat current R & D expenses as deferred expenses and deduct them from taxable income over a period *not less* than 60 months from the time at which the taxpayer first realizes benefits from the research expenditures.[2] As far as current R & D expenses are concerned then, the U.S. taxpayer has a choice between deducting them in the tax year in which they are incurred or capitalizing them and deducting them in a pro rata fashion over a minimum of 5 years. (This clearly offers much less flexibility than the Canadian system, which allows the deduction of current R & D expenditures in the tax year of the taxpayer's choosing.)[3]

Expenditures for R & D facilities and equipment must be capitalized and depreciated against future income. Depreciation charges may then be taken in the year the taxpayer is eligible to take them or deferred and deducted over a minimum period of 5 years.[4] R & D equipment may be depreciated over a period of not less than 3 years.[5] Structures such as laboratories may be depreciated over a period of not less than 15 years.[6] Some R & D expenditures of a capital nature are eligible for the 10 per cent investment tax credit. This credit does not reduce the amount of the deduction otherwise available. Expenditures eligible for the credit include R & D equipment (under "tangible personal property with a useful life of more than three years") and research facilities, which would include wind tunnels, test stands, and the like, but not research buildings.[7]

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[1] Internal Revenue Code, 1977, subsection 174(a).

[2] Ibid., at subsection 174(b).

[3] See the discussion in Chapter 3 under the heading "The Evolution of the Tax Treatment. . . ."

[4] National Science Foundation, *Corporation Income Tax Treatment of Investment and Innovation Activities in Six Countries*, PRA Research Report 81-1 (Washington, D.C.: National Science Foundation, 1981), 154.

[5] Economic Recovery Tax Act of 1981, Pub. L. No. 97-34, 95 Stat. 14, enacted on August 13, 1981, 14.

[6] Ibid., at 16.

Until 1981, the United States offered no special allowances or credits for R & D. The Economic Recovery Tax Act of 1981[8] introduced a tax credit equal to 25 per cent of incremental R & D expenditures made after June 30, 1981 and before January 1, 1986. Incremental expenditures are defined as the excess of qualified R & D expenditures for the tax year over the average of the three preceding years. Qualified R & D expenditures include

- in-house research expenses, which include research wages and supplies, plus certain lease or other charges for the use of R & D equipment; and
- contract research expenses, which qualify for the credit in the amount of 65 per cent of payments made to research firms or universities.[9]

As is the case with all such credits, this one is asymmetric in that there is no increase in taxes if R & D expenditures fall in nominal terms. It is also based on nominal rather than real increases in R & D. Given the three-year, moving-average base period, a 10 per cent annual rate of inflation will itself result in a tax credit of (.25)(.23), or 5.75 per cent of the qualified annual R & D expenditures of a taxpayer who maintains a constant real level of R & D spending.

In addition to the annual tax saving due to inflation, there is a one-time tax saving equal to 25 per cent of each dollar added to planned annual R & D spending. If the rate of interest is 15 per cent, this tax saving has an annual value of $(.25)(.15)(1-.46)$, or \$.02 per dollar of qualified R & D spending. The total effect of the credit is therefore to reduce the after-tax cost of qualified R & D by \$.078 per dollar spent.

In summary, U.S. tax treatment of R & D expenditures has been and continues to be considerably less generous than the Canadian treatment. It allows less flexibility in the deduction of current R & D expenses. It requires that R & D equipment and structures be written off over a minimum of 3 and 15 years respectively rather than immediately as is the case in Canada. The 10 per cent investment tax credit applies only to R & D equipment rather than to all R & D expenditures as is the case in Canada. The recently adopted 25 per cent credit for incremental R & D is, however, very similar to the 50 per cent allowance for incremental R & D that exists in Canada.

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[7] *U.S. Master Tax Guide 1981* (Chicago: CCH, 1980), 447; supra footnote 4, at 151.

[8] See in general, supra footnote 5.

[9] Ibid., at 25.

The United Kingdom

Expenditures on scientific R & D of both a current and a capital nature may be deducted in their entirety from taxable income in the tax year in which they are incurred.[10] Unused deductions may be carried forward for up to five years.[11] Britain offers no tax credits or additional special allowances for R & D spending.

The Federal Republic of Germany

German tax law provides for the deduction of current R & D expenditures from taxable income in the year in which they are incurred. Minor capital expenditures on R & D (up to DM 800) may also be written off in the year in which they are incurred. Companies are permitted to carry forward operating losses for up to five taxable years. Losses up to a maximum of DM 5,000,000 may also be carried back up to one year.[12]

Capital expenditures on R & D in excess of DM 800 must be depreciated over their economic life. For most purposes there is no accelerated depreciation of capital expenditures on R & D.[13] Exceptions are made, however, for capital expenditures made in Berlin and in areas bordering on the German Democratic Republic (GDR). In the case of Berlin, 75 per cent of the cost of an asset may be written off in the year of acquisition and the next four years. In the case of areas bordering on the GDR, the amount allowed during the same period is 50 per cent for movable assets and 40 per cent for immovable assets. This is in addition to the straight-line depreciation normally allowed.[14] It is clear that even in these exceptional cases, the present value of the write-off allowed on capital expenditures for R & D is less than that allowed in Canada.

Under its Investment Premium Law, the Federal Republic provides for a 20 per cent tax credit on the first DM 500,000 and 7.5 per cent on the balance spent in any given year on *depreciable* assets used for R & D purposes.[15] To qualify for the premium, two-thirds of investments in fixed assets must be used for R & D and must be so used for three years. Movable assets must be used entirely for R & D for three years.[16] The tax credit does not reduce the amount of the deductions that are otherwise available.[17]

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[10] U.K. Capital Allowance Act, 1968, section 9; International Bureau of Fiscal Documentation, *The Taxation of Companies in Europe* (Amsterdam: the Bureau) (looseleaf service), paragraph 186.

[11] *Simon's Taxes* (London: Butterworths) (looseleaf service), paragraphs B2.711 and B2.901.

[12] International Bureau of Fiscal Documentation, *The Taxation of Companies in Europe* (Amsterdam: the Bureau) (looseleaf service), paragraphs 256 and 256a.

[13] E. Jehle, "German Federal Republic: The Tax Treatment of Research and Development" (1978), 18, no. 3 *European Taxation* 345-56, at 345-47.

[14] Supra footnote 4, at 43.

[15] Supra footnote 12, at paragraph 209; Federal Republic of Germany, *Sixth Report of the Federal Government on Research* (Bonn: The Federal Minister for Research and Technology, Press and Public Relations Division, 1980), 30.

While the German R & D tax credit does not reduce the deductions otherwise available and in that sense is more generous than the Canadian credit, it should be kept in mind that the German credit is available only on the capital component of R & D expenditures, whereas the Canadian credit is available on the entire expenditure. Indeed, even for a firm benefiting from the accelerated write-off provisions described above, the tax credit may be just equivalent to the immediate write-off of R & D capital offered by Canada.

France

French tax law provides for the full deduction from taxable income of current R & D expenses in the tax year in which they are incurred.[18] Operating losses may be carried forward and applied against operating income for up to five taxable years.[19] Although there is some dispute about it, deductions may also be preserved by treating current R & D expenses as "formation expenses."[20] Formation expenses may be written off when incurred or over a period that is normally three to five years. The amortization of formation expenses is not subject to the five-year limit on carryforward losses and thus provides more flexibility to a corporation attempting to make use of all the deductions for which it is eligible.

Capital expenditures on R & D may not be deducted in their entirety in the tax year in which they are incurred. Buildings will generally be depreciated at 5 per cent per year and machinery at 10 to 20 per cent per year on a straight-line basis.[21] Buildings used for research are, however, eligible for a 50 per cent special depreciation allowance. As well, 50 per cent of the cost of buildings used solely for scientific and technical research may be deducted from taxable income in the year in which the asset is acquired. The balance of the cost must be depreciated over the remaining useful life of the asset.[22] As of July 1979, this 50 per cent allowance is also available on equipment and tools used in R & D. Again, the remaining portion of the cost of these tools and equipment is to be depreciated over their useful life. This tax reduction applies only to firms with *fewer* than 2,000 employees and excludes any company whose voting stock is more than 50 per cent controlled by companies quoted on the stock exchange.[23]

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[16] Supra footnote 12, at paragraph 211.

[17] Ibid., at paragraph 213.

[18] Ibid., at paragraph 296.

[19] Ibid., at paragraph 494.

[20] Ibid., at paragraph 380.

[21] Ibid., at paragraph 387.

[22] C. Sibille, "France: Tax Treatment of Research and Development and the Result of Research" (1978), 18, no. 3 *European Taxation* 76-93, at 78-80; supra footnote 12, at paragraph 394.

Another deduction available (as of December 30, 1980) to firms engaged in R & D, among others, is a deduction equal to 10 per cent of the cost of qualifying investments including scientific and research equipment provided that it has a useful life of at least three years. This deduction does not reduce the amount of other deductions available.[24] Given the French corporate tax rate of 50 per cent, this allowance would have the effect of reducing the after-tax cost of R & D equipment by 5 per cent.

France also maintains a system of cash grants for R & D that does not operate through the tax system but is similar to programs in other countries that do. Except in the Paris Basin area, companies creating or developing scientific or technical research departments may be entitled to a cash grant of 15 to 20 per cent of the value of the expenditure involved, up to a maximum of FF 25,000 per job created. New activities must create at least 10 permanent new jobs, while expansions must add 50 persons to the taxpayer's labour force. These grants are taxable.[25]

Japan

Corporations engaged in R & D in Japan may deduct their current R & D expenses in full from their taxable income in the year in which these expenses are incurred. If taxable income is less than R & D expenses, the latter may be deferred. Deferred expenses must be amortized on a straight-line basis over the useful life of the research.[26] Japanese tax law also provides for a carryforward of operating losses for up to five years.[27]

Capital expenditures for R & D purposes must be depreciated over their useful lives. For tax purposes, the useful life of R & D equipment runs from four to seven years. Capital expenditures for R & D purposes may also be eligible for special depreciation, which allows an additional deduction from taxable income in the year the asset is acquired. The total deduction is not, in any case, to exceed the value of the asset acquired.[28]

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[23] Francis Lefebvre, "France: New Tax Incentives for Investments," September 1979 *Tax Management International Journal* 23-24 and 27, at 23 and 27.

[24] Francis Lefebvre, "France: Fiscal Investment Incentives Adopted," April 1981 *Tax Management International Journal* 12-13, at 12.

[25] Supra footnote 12, at paragraphs 409a-411b.

[26] Yuji Gomi, *Guide to Japanese Taxes 1979-80* (Tokyo: Zaikei Shoho Sha, 1979), S.212; Japan, Tax Bureau, Ministry of Finance, *An Outline of Japanese Taxes 1980* (Tokyo: 1980), 79.

[27] Japan, Tax Bureau, Ministry of Finance, supra, at 96.

[28] Supra footnote 4, at 101; Japan, Tax Bureau, Ministry of Finance, supra footnote 26, at 82-85.

Since 1966, Japan has offered a tax credit for R & D expenditures. The credit applies to current R & D expenses as well as to depreciation and overhead charges. It is equal to 20 per cent of the excess of current expenditures over the largest amount of such expenditures in any prior tax year since 1966. The maximum credit obtainable is 10 per cent of corporate income tax payable.[29] The credit does not reduce the R & D deductions otherwise available.[30] Since the credit is based on increases in nominal R & D spending, an annual inflation rate of 10 per cent will itself result in a reduction in the after-tax cost of R & D of (.20)(.10), or $.02 per dollar spent provided the taxpayer maintains a constant level of real R & D spending. This credit also results in a one-time tax saving equal to 20 per cent of each dollar added to the annual R & D budget. If the rate of interest is 15 per cent, the annual value of this tax saving is (.20)(.15)(1 − .40), or $.018 per dollar of R & D. The total value of the credit under these circumstances is therefore $.038 per dollar of R & D spending.

Japan also allows for a special deduction of up to 40 per cent of corporate income for firms having derived all or part of their income from "overseas transactions in technical services." The deductions range from 8 per cent of income received from the sale of copyrights for foreign currency, to 16 per cent of income received from the sale of consulting services for foreign currency, and to 28 per cent of income received from the sale of patents and know-how for foreign currency. Given the Japanese corporate tax rate of 40 per cent, this provision implies that, insofar as a one-dollar R & D expenditure produces technology that is sold abroad (for one dollar), its after-tax cost is reduced by $.11.

Some Small Developed Countries

Austria

Austrian tax regulations provide that 105 per cent of current expenses incurred in the development and improvement of economically valuable inventions may be deducted from taxable income in the tax year in which they are incurred.[31] Operating losses may be carried forward for five taxable years.[32] A deduction of 80 per cent of the cost of a fixed asset used for R & D purposes may be made from taxable income in the tax year in which the asset is acquired. The remainder of the cost of the asset must be written off in four equal annual instalments.[33] Austria offers no tax credits or special allowances for R & D other than the 105 per cent write-off of current expenses.

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[29] Gomi, supra footnote 26, at S.260; Japan, Tax Bureau, Ministry of Finance, supra footnote 26, at 104.

[30] Gomi, supra footnote 26, at S.258.

[31] Supra footnote 12, at paragraph 99(5).

[32] Ibid., at paragraph 196.

Australia

The Australian Income Tax Assessment Act[34] provides for full deduction of current R & D expenses from taxable income in the year in which these expenses have been incurred. Losses may be carried forward for seven years.[35] R & D expenditures of a capital nature must be depreciated over a three-year period—that is, on a straight-line basis at $33^{1}/_{3}$ per cent per year or on a declining balance basis at 50 per cent per year.[36]

Australia does not at present have any general tax incentives applying to R & D. Between 1967 and 1976, Australia offered grants equal to 50 per cent of incremental R & D expenditures with a maximum grant of A$25,000 per year. Except for its $25,000 limit, this grant program was similar to the IRDIA incentive offered by Canada during the same period. Both programs differed from those now offered by Canada, the United States, and Japan, among others, in that they had the same value for firms without any taxable income as they did for firms with taxable income. In other respects, again excepting its $25,000 maximum payment, it was similar to the schemes now in operation. During its nine-year existence, the Australian general grant program disbursed only $93 million and was apparently regarded by local commentators as a failure.[37]

Between 1967 and 1974, Australia also offered selective R & D grants to firms that increased R & D expenditures by more than $50,000 over a base period. It presently offers commencement grants of up to $25,000 for firms with no prior R & D spending. In both cases the grants, while based on increases in R & D spending, were or are subject to negotiation and budgetary considerations and are therefore not analogous to the tax incentives offered elsewhere.

Belgium

Belgian tax law provides for the deduction of current R & D expenditures in the tax year in which they are incurred.[38] Losses may be carried forward for up to five years.[39] R & D expenditures of a capital nature must be capitalized. Equipment used for purposes of R & D may be depreciated using the straight-line method at $33^{1}/_{3}$ per cent per year on the basis of 110 per cent of the cost of the asset.[40] Buildings must be depreciated on a straight-line basis at 5 per cent per year.[41]

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[33] Ibid., at paragraphs 131, 133 and 133a.

[34] Australia, Income Tax Assessment Act 1936, reprinted as of December 31, 1980 (Canberra: Government Printer, 1981) s. 73A(1).

[35] E. F. Mannix and J. E. Mannix, *Australian Income Tax Guide* (Sydney: Butterworths, 1981), paragraphs 1801-02.

[36] Supra footnote 34, at s. 73A(2) and s. 73A(5); ibid., at paragraph 1351.

[37] Australia, Committee of Inquiry into Technological Change in Australia, *Technological Change in Australia*, Selected Papers on Technological Change, Vol. 4 (Canberra: Government Publishing Service, 1980), 299.

Belgium did not offer any additional tax incentives for R & D until recently. Two special allowances are or have recently been in effect. The first is the additional investment allowance that was in effect for 1979-80 and 1980-81. This allowance is equal to 15 per cent of the difference between investment in 1980 and average investment over the period 1975-1977, and 15 per cent of the difference between 1979 investment and average investment over the period 1974-1976. To the total increase in investment obtained in this manner is added 50 per cent of 1979 or 1980 R & D spending.[42]

For example, suppose that a firm has maintained R & D expenditures constant in real terms since 1975 and that there has been a 10 per cent annual rate of inflation. For every dollar spent in 1975, nominal R & D spending in 1980 would amount to $1.61. The increase over the 1975-1977 average would be $.51. Since the entire investment is R & D in this case, this increase is scaled up by 50 per cent for a total increase of $.766 per constant dollar of R & D spending. The allowable deduction is then 15 per cent of the scaled-up increase or $.115 per constant dollar of R & D spending. Given the Belgian corporate tax rate of 48 per cent, there is a tax saving of $.055 per constant dollar of R & D spending.

The Belgian allowance also yields a one-time tax saving equal to (.48)(.15)(1.5), or $.108 for each dollar added to the annual R & D budget. If the rate of interest is 15 per cent, the value in annual terms of this tax saving is .108(.15)(1 − .48), or $.008 per constant dollar of R & D spending. Under these circumstances, the total tax saving associated with the Belgian credit is $.063 per constant dollar of R & D spending.

The second incentive came into effect in January 1981. Companies may deduct BF 100,000 per annum for each new research person employed after January 1, 1981. Research personnel employed before January 1, 1981, do not qualify for this incentive.[43] In addition to these incentives, Belgium also maintains a set of regional development incentives for which capital investments made for R & D purposes are eligible.[44]

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[38] Supra footnote 12, at paragraphs 123-5; C. Sibille, "Belgium: Tax Measures and Direct Incentives Applicable to Research and Development" (1977), 17, no. 8 *European Taxation* 256-66, at 256.

[39] Supra footnote 12, at paragraph 194.

[40] Ibid., at paragraph 158; Philippe-Francois Lebrun, "Belgium: 4. Economic Recovery Plan Enacted," May 1981 *Tax Management International Journal* 41.

[41] Sibille, supra footnote 38, at 257-59.

[42] Supra footnote 12, at paragraphs 163d and 163e.

There is no indication that the additional investment allowance that was in effect for the 1979-80 and 1980-81 tax years has been extended to apply to subsequent tax years. There has, however, been a reduction in the Belgian corporate tax rate from 48 to 45 per cent. This reduction takes effect in the 1982-83 tax year.[45] The net effect of the expiry of the additional investment allowance and the reduction in the corporate tax rate is to increase the after-tax cost of R & D in Belgium and to raise the Belgian B-index. Our international comparison of B-indexes is based on the tax treatment of R & D as of 1981. It should be kept in mind that were this comparison made on the basis of tax measures in place in 1982, the Belgian system would not rank as highly in terms of the value of the R & D incentives it offers.

Denmark

Danish tax law provides for the full deduction of current R & D expenses in the tax year in which they are incurred.[46] Capital expenditures for R & D purposes may also be deducted in full in the tax year in which these expenditures are incurred.[47] If income is insufficient to utilize these deductions, R & D expenditures may be capitalized and depreciated over five years on a straight-line basis.[48] Denmark offers no special allowances or tax credits for R & D.

Italy

As of December 30, 1980, current R & D expenses may be deducted either in the tax year in which they have been incurred or in equal instalments in that tax year and in subsequent tax years up to but not beyond the fourth tax year. This provision applies to both personal and corporate income and is retroactive to 1974. Previously, R & D expenses were deductible up to an amount not exceeding 50 per cent in the tax year in which they were incurred, with the balance to be depreciated over five years if the research succeeded and to be deducted entirely in the following tax year if it failed.[49] Capital expenditures for R & D must be depreciated over the useful life of the asset involved using the straight-line method. Italy allows neither a tax credit nor a special allowance for R & D spending.

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[43] Ibid., at paragraph 163f.

[44] Sibille, supra footnote 38, at 259-60.

[45] "Belgium: Rate Reduction" (1982), 22, no. 5 *European Taxation* 148-50, at 148.

[46] Supra footnote 12, at paragraph 136.

[47] Ibid., at paragraph 236.

[48] Ibid.

[49] Giuseppe Bisconti, "Italy," May 1981 *Tax Management International Journal* 42; Guiseppi Bisconti, "Italy" (April 1981), 8 *Tax Planning International Review* 14-15, at 15.

Norway

Current R & D expenditures may either be capitalized and amortized according to the general amortization provisions for intangible assets or written off completely in the year in which they are incurred. Capital expenditures for R & D must be depreciated over their useful lives.[50] Norwegian tax law also provides for a carryforward of operating losses for up to 10 years. Norway does not offer either tax credits or special allowances for R & D but it does provide for a research reserve into which 20 per cent of taxable income may be directed annually. This reserve has the effect of allowing firms to take deductions from taxable income in anticipation of engaging in future R & D when income may not be sufficient to support it.

Spain

Current R & D expenses may be deducted from taxable income in the tax year in which they are incurred.[51] Current R & D expenses may also be capitalized and amortized as an intangible asset.[52] Operating losses may be carried forward for a maximum of five years.[53] Insofar as capital expenditures for R & D purposes are concerned, it appears as if the taxpayer may elect to deduct them in the tax year in which they are incurred or to capitalize them and write them off over their nominal life.

Spain also offers a 10 per cent tax credit on R & D expenditures, provided these expenditures are capitalized and not deducted as a current business expense. This 10 per cent credit is increased to 15 per cent if the company involved does not reduce the number of its employees for 2 years after the investment is made.[54] The maximum credit that may be taken in any one year is 30 per cent of the firm's tax liability for that year. Unused credits may be carried forward for three tax periods.[55]

While this credit may appear relatively generous, it should be kept in mind that it can be used only when R & D expenses are capitalized. The credit will involve a tax saving only if it is not offset by the decline in the present value of the deduction. Thus, with Spain's 33 per cent tax rate, a 10 per cent credit is equivalent to a 30 per cent deduction. If the present value of the depreciation (amortization) charges on $1 in R & D were to fall from $1 (immediate write-off) to $.70, the effect of the credit would be nullified. This would be the outcome, for example, with an amortization rate of 35 per cent per year declining balance and a 15 per cent discount rate. If the write-off were slower or the discount rate higher, the tax credit would not reduce the after-tax cost of R & D.

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[50] Supra footnote 12, at paragraph 158.

[51] Ibid., at paragraph 216; W. A. Comello, "Corporate Taxation in Spain" (1980), 20, no. 1 *European Taxation* 13, at 14, paragraph 4(a).

[52] Supra footnote 12, at paragraph 251a.

[53] Comello, supra footnote 51, at 13.

[54] Ibid., at 14.

[55] Supra footnote 12, at paragraph 391b.

Sweden

Swedish tax law allows the deduction of current R & D expenditures from taxable income in the tax year these expenditures are made.[56] Operating losses may be carried forward for up to 10 years.[57] Capital assets used for R & D purposes must be depreciated over their normal economic life in general by the straight-line method. Research laboratories, for example, may be depreciated at 4 per cent annually.[58]

Since 1974, Sweden has maintained a special R & D allowance, the value of which depends on both the level of and the year-to-year increase in wage payments to R & D personnel. The first component of this special allowance is the base deduction, which is equal to 10 per cent of the calculation base. The calculation base is equal to current wage payments to R & D personnel grossed up by two-thirds. The base deduction is therefore 16.7 per cent of the wage component of current R & D expenditures. Assuming that 60 per cent of R & D expenditures are in the form of wage payments to research personnel,[59] Swedish firms are allowed a base deduction of $.10 per dollar of R & D spending. Given Sweden's 40 per cent corporate tax rate, this implies a reduction in the after-tax cost of R & D of approximately $.04 per dollar of R & D spending.

The second component of the special allowance is based on year-to-year changes in the calculation base. This supplementary deduction is equal to 20 per cent of the year-to-year change in the calculation base. A firm that maintained its real annual R & D expenditures or the real value of its stock of technology in the face of a 10 per cent annual rate of inflation would be eligible for an annual supplementary deduction equal to 1.2 per cent of its constant dollar of R & D spending. This implies a further reduction in the after-tax cost of R & D of $.005 per dollar spent ((.60)(.20)(.10)(.40)). Finally, the supplementary deduction also yields a one-time tax saving equal to (.60)(.20)(.40), or $.048 for each dollar added to the annual R & D budget. If the rate of interest is 15 per cent, the annual value of this tax saving would be (.15)(1 − .40)(.048), or $.004 per constant dollar of R & D spending.

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[56] Ibid., at paragraph 157.

[57] Ibid., at paragraph 344.

[58] Ibid., at paragraphs 213 and 216.

[59] See Table 2.2.

In sum, under the circumstances we have outlined, the Swedish special allowance has the total effect of reducing the after-tax cost of R & D by $.040 + $.005 + $.004, or $.049 per constant dollar of R & D spending. There are several limitations on the availability of the special allowance. Neither the base deduction nor the supplementary deduction is allowed if the calculation base and the change in the calculation base respectively are less than SKR 5,000. The calculation base must be reduced by the amount of any grants or subsidies received. Research carried out by independent parties qualifies for a deduction on the basis of actual rather than grossed-up costs. Research carried out abroad qualifies for deductions only on the first SKR 250,000 of spending per year.[60]

Sweden has recently introduced some changes in the method by which the special allowance for R & D is calculated. Effective January 1, 1982, the base deduction has been reduced from 10 to 5 per cent of the calculation base. The calculation base has been increased from 167 to 250 per cent of wage and salary payments to R & D personnel. The base deduction has therefore been reduced to 12.5 from 16.7 per cent of the wage and salary component of R & D expenditures.[61] Assuming again that 60 per cent of R & D expenditures are in the form of wage payments to research personnel, Swedish firms are now allowed an annual base deduction of (.60)(2.50)(.05), or $.075 per dollar of R & D spending. Given Sweden's 40 per cent corporate tax rate, this implies a reduction in the after-tax cost of R & D of $.03 per dollar of R & D spending.

The reduction in the allowed base deduction will be somewhat smaller than is implied by the above calculations. Sweden has also broadened the definition of R & D personnel to include any employee spending more than 25 per cent (as opposed to 50 per cent previously) of his time on R & D. Thus a larger fraction of a firm's total wage bill will be included in the calculation base. This is not reflected in our calculations.

The calculation of the second component of the special allowance was also changed, effective January 1, 1982. The second component or supplementary deduction is now equal to 30 per cent rather than 20 per cent of the year-to-year change in the calculation base. A firm that maintains its real

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[60] Supra footnote 12, at section 2.3.5.1.; Organization for Economic Cooperation and Development, *Selected Industrial Policy Instruments* (Paris: OECD, 1978), 63; Touche Ross International, *Investment and Taxation in Sweden* (Stockholm: Touche Ross International, 1979), 15.

[61] Sten Hamberg, "Sweden," January 1982 *Tax Management International Journal* 37-39, at 38.

R & D expenditures in the presence of a 10 per cent annual rate of inflation would be eligible for a supplementary deduction of (.30)(.10)(.60) or 1.8 per cent of its constant dollar of R & D spending. This implies a reduction in the after-tax cost of R & D of (.30)(.10)(.60)(.40), or .7 per cent of annual constant dollar R & D spending. The second component of the special allowance also yields a one-time tax saving, the value of which, as of January 1982, is (.60)(.30)(.40), or \$.072 per dollar added to the annual R & D budget. If the rate of interest is 15 per cent, the annual value of this tax saving will be \$(.072)(.15)(1−.60), or \$.004 per constant dollar of R & D spending.

Taken together, both components of the 1982 version of the Swedish special allowance have the effect of reducing the after-tax cost of R & D by \$.030+\$.007+.004, or \$.041 per constant dollar spent. The net effect of the changes introduced in January 1982 is (1) to reduce the total value of the special allowance, and thus to increase the after-tax cost of R & D, and (2) to increase the portion of the special allowance that is based on increases in nominal R & D spending as opposed to the level of R & D spending.

The 1982 changes will also have the effect of raising Sweden's B-index. If our international comparison were based on tax measures in place in 1982 rather than measures in place in 1981, Sweden would rank somewhat lower in terms of the generosity of its tax treatment of R & D.

Other Small Developed Countries

Information was sought on the tax treatment of R & D by several other small developed countries, especially Switzerland and the Netherlands. In neither case was there any mention of R & D expenditures in the usual references on national tax codes. Interviews with embassy economic counsellors indicated that neither country had in its national tax code any specific provisions regarding R & D expenditures. For this reason, this discussion is confined to a sketch of how R & D expenditures are likely to be treated for tax purposes in these two countries.

In Switzerland, it can be inferred that current R & D expenses, like all current business expenses, may be deducted from taxable income in the year in which they are incurred. There is, in general, no deferral of ordinary business expenses; they must be deducted in the year incurred.[62] Losses may be carried forward into the next tax period (two calendar years) for federal tax purposes. Insofar as the cantons are concerned, losses may be carried forward from one to five years.[63]

Fixed business assets must be depreciated over their useful lives generally using the declining balance method.[64] There is no accelerated depreciation, nor is there any system of investment allowances or credits.[65] We can infer, then, that capital expenditures for R & D purposes must be depreciated over their normal service lives.

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[62] Supra footnote 12, at paragraph 191

[63] Ibid., at paragraphs 281-83.

The absence of accelerated depreciation and any special allowances or credits might be taken to imply that the after-tax cost of R & D and the B-index will be relatively high in Switzerland. This is certainly true of the after-tax cost of R & D, but it is not true of the B-index. Swiss corporate tax rates run from 3.6 to 9.8 per cent depending on the canton. As a consequence, the value of deductions postponed will be very small. Moreover, as was demonstrated earlier,[66] a low corporate tax rate mitigates the effect of special credits or allowances, or their absence, on the B-index. For this reason, the Swiss B-index is likely to be close to 1, making Switzerland one of the less generous, but not the least generous, of the nations examined in its tax treatment of R & D. It is clearly less generous than Canada.

In the Netherlands, all current expenses incurred in connection with the conduct of the business or that are in the management's opinion made for good business reasons are deductible in the tax year in which they are incurred.[67] The implication is that current R & D expenses may be deducted in the tax year in which they are incurred. Losses may be carried forward for eight tax years.[68]

Capital assets, apparently including those employed in R & D, must be depreciated over their useful life. As of May 1978, there is no accelerated depreciation, although there are tax credits for capital investment, presumably including R & D facilities and equipment. There is a basic credit (investment premium) equal to, for example, 18 per cent of the value of new buildings or 11 per cent of the value of existing buildings acquired.[69] Supplementary credits (bonuses) exist for special types of investment, such as in energy and environmental areas. Basic plus supplementary credits may amount to as much as 50 per cent of the value of a new building and they are not taxable.[70] R & D facilities would presumably be eligible for these credits. The Netherlands also offers tax credits for investment in designated regions of the country under the Investment Premium Regulation.[71]

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[64] Ibid., at paragraphs 221-22.

[65] Ibid., at paragraphs 236-37.

[66] See Chapter 2 under the heading "A Summary Measure . . . the B-Index."

[67] Supra footnote 12, at paragraph 152.

[68] Ibid., at paragraph 227.

[69] Ibid., at paragraph 194.

[70] Ibid., at paragraph 185.

[71] Ibid., at paragraph 197-97c.

The Netherlands maintains a corporate tax rate of 48 per cent.[72] The tax credit for investment in R & D facilities if not in equipment may be sufficient to compensate for the fact that neither facilities nor equipment may be written off at an accelerated rate. In this case, the B-index would be close to 1. This would put the Netherlands among the countries with a less favourable tax treatment of R & D than Canada's.

Some Less-Developed Countries

Brazil

Brazilian tax law provides for the full deduction of current business R & D expenditures in the tax year in which they are incurred. Operating losses may be carried forward for four years. Capital assets acquired for R & D purposes must be depreciated over their economic life. Brazil offers neither special allowances nor tax credits for R & D.[73]

Mexico

Income tax law in Mexico permits a complete write-off of current R & D expenses in the year in which they are incurred provided that they are necessary for the purposes of the business involved.[74] Operating losses may be carried forward for three years, and losses incurred in the first three years of business activity may be carried forward for four years.[75] Capital assets used for R & D purposes are accorded no special tax treatment. In the case of equipment used directly for research on new products or technological development in Mexico, the maximum rate of depreciation is 35 per cent annually.

In November 1980, the Mexican government introduced a wide range of tax incentives for the promotion and sale of domestic technological R & D. Four types of incentives are involved: (1) incentives for individuals and entities dedicated exclusively to R & D, (2) incentives for educational and research institutions, (3) incentives for productive enterprises undertaking R & D as part of their activities, and (4) incentives for purchasers of domestic technology.

For productive enterprises (3), the incentive consists of a tax credit equal to a percentage of the net purchase price of machinery and equipment directly related to the performance of R & D. If the enterprise involved is engaged in priority activities (farm industries, capital goods, durable goods, nondurable goods, and intermediate goods), the credit is 20 per cent. Otherwise the credit is 15 per cent unless a small business is involved, in which case a 25 per cent credit is allowed. In addition, a further tax credit of 10 per cent is allowed on the sale price of technology developed in Mexico and sold to third parties. Neither of these credits reduces deductions that would otherwise be available.[76] A final incentive involves a tax credit equal to 10 per cent (15 per cent for small businesses) of payments for technological R & D services, technological assistance, adaptation and assimilation of technology, and basic engineering, all from Mexican sources. The purchase or licensing of patents and trademarks does not qualify unless they include a "significant technological content."[77]

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[72] Ibid., at paragraph 228.

[73] International Bureau of Fiscal Documentation, *Corporate Taxation in Latin America* (Amsterdam: the Bureau) (looseleaf service), 11-13.

[74] Ibid.

[75] Ibid., at 9.

To put the Mexican credits in perspective, we should note that they are for the purchase of R & D equipment, the purchase of R & D services from other firms and institutions, and the sale of technology to third parties. It was shown in Chapter 2 that the capital component of the R & D dollar is 10 per cent, with equipment assumed to account for half of this. Domestic extramural R & D amounts to approximately 8 to 10 per cent of total industrial R & D spending. Royalty income might again amount to something over 5 per cent of industrial R & D spending.[78] In sum, none of these incentives applies to a very large fraction of the R & D dollar. If we take these rough weights as a guide, the first two credits would have the effect of reducing the after-tax cost of an average dollar of R & D spending by [(.20)(.10)+(.10)(.08)], or $.028.

Hong Kong

Both current and capital expenditures on R & D may be deducted from taxable income in the tax year in which they are incurred.[79] Operating losses may be carried forward indefinitely.[80] Hong Kong offers no credits or special allowances for R & D.

South Korea

Current expenditures on R & D may be deducted from taxable income in the tax year in which they are incurred. Fixed assets engaged in R & D activity must be depreciated over their useful lives, but they are eligible for additional depreciation of 50 per cent of their acquisition cost in the year in which they are acquired. The remainder of the cost of the asset must be depreciated over its useful life.[81]

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[76] Ulises Schmill Ordonez and Gurria Luis De Valle, "Mexico," March 1981 *Tax Management International Journal* 34, at paragraph C.

[77] Ibid., at paragraph D.

[78] R. Wilson, *The Sale of Technology through Licensing*, Study no. PB-244 159 (Washington, D.C.: National Science Foundation, 1975).

[79] United Kingdom, Board of Inland Revenue, *Income Taxes Outside the United Kingdom: Hong Kong 1976-1977 to 1978-1979* (London: HMSO, 1979), paragraph 15.1(h).

[80] Deloitte Haskins and Sells, International Tax Service, *Taxation in Hong Kong* (New York: Deloitte Haskins and Sells, 1981), paragraph 7.07.

Korean enterprises may also set aside 20 per cent of their taxable income as a technological development reserve. If it is not used for this purpose within two years, it is again regarded as taxable income. Like the research reserve offered in Norway, this reserve simply allows firms to take R & D deductions earlier than they would be able to otherwise.

Singapore

As of April 1, 1980, a taxpayer may deduct 200 per cent of current expenditures on trade- or business-related R & D undertaken by him or through an approved R & D organization during the tax year in which these expenditures are incurred.[82] Capital expenditures on plant and machinery for R & D purposes may be written off on a straight-line basis at $33^1/_3$ per cent per year.[83] Operating losses may be carried forward indefinitely provided there is no substantial change in the ownership of the firm. Manufacturing companies proposing to engage in R & D may also qualify for an investment allowance of up to 50 per cent of the cost of the buildings and machinery required. The allowance serves to reduce taxable income and may be carried forward until it is fully utilized. This allowance is in addition to the usual depreciation allowances claimable on such assets.[84]

Given Singapore's 40 per cent corporate tax rate, the after-tax cost of a one-dollar *current* expenditure on R & D would be

$$\$1(1-(.4)(2)) = \$.20.$$

If we take a composite R & D dollar, 90 per cent current expenditures and 10 per cent capital, and assume that the capital expenditures are not eligible for the investment allowance and that the discount rate is 15 per cent, the after-tax cost of a one dollar R & D expenditure is

$$\$[1-(.9)(.4)(2)-(.1)(.4)(.88)] = \$.25.$$

This would imply a B-index of .42.

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[81] United Kingdom, Board of Inland Revenue, *Income Taxes Outside the United Kingdom: Republic of Korea 1975* (London: HMSO, 1977), paragraphs 28(4) and 4(a); Deloitte Haskins and Sells, International Tax Service, *Taxation in Korea* (New York: Deloitte Haskins and Sells, 1981), paragraph 7.02.

[82] James Chia Shih Ching, "Singapore: A 1980 Income Tax Act (Amendment No. 2)," January 1981 *Taxation Management International Journal* 34-35, at 34.

[83] Ibid.

[84] Ibid., at 35; Brij S. Soin, "Singapore Tax Incentives" (February 1980), 7 *Tax Planning International Review* 31-32, at 31.

If it is assumed that the capital component of the composite R & D dollar is eligible for the investment allowance, which is taken to be the maximum of 50 per cent and claimed immediately, the after-tax cost is

$$\$[1-(.9)(.4)(2)-(.1)(.4)(.50)-(.1)(.4)(.88)] = \$.23.$$

The B-index would be .38. As the discussion and associated calculations in the next chapter will indicate, this is the most generous tax treatment of R & D available in any of the countries examined.

Taiwan

Current expenditures on R & D are deductible from taxable income in the tax year in which they are incurred provided they do not exceed 2 per cent of gross income. Any excess may be carried forward. Any equipment used for R & D that has a service life in excess of two years must be depreciated. R & D equipment is eligible for accelerated depreciation. Equipment with a service life of 10 years or less may be depreciated within one-half of its service life.[85] Operating losses may generally be carried forward for three years.[86] Taiwan offers no credits or special allowances for R & D.

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[85] Deloitte Haskins and Sells, International Tax Service, *Taxation in Taiwan, ROC (Republic of China)* (New York: Deloitte Haskins and Sells, 1981), 7; Chien-Shien Wang, "Taiwan: Tax Incentives for the Encouragement of Investment," April 1981 *Tax Management International Journal* 17-18, at 17.

[86] Deloitte Haskins and Sells, supra footnote 85, at paragraph 7.08.

5

Implications of the Analysis of Tax Measures

Tax Arrangements Relating to R & D: A Summary

The characteristics of the tax environment of R & D in 20 countries are summarized in Tables 5.1 to 5.3. Table 5.1 compares the tax treatment accorded R & D by Canada with that of five major industrial countries: the United States, the United Kingdom, France, Germany, and Japan. Table 5.2 compares Canada with eight small developed countries. Table 5.3 compares Canada with six less-developed countries.

Taking all countries together, the following general characteristics emerge:

1) All countries examined offer an immediate write-off of current R & D expenditures as a current business expense.

2) Canada, Hong Kong, and Singapore allow for an indefinite deferral of deductions for current R & D expenditures. All other countries place a limit on the time period over which unused deductions for current R & D expenses may be carried forward and some restrict the rate at which R & D expenses, once deferred, may be written off. The latter group includes the United States, Japan, Italy, and Spain.

3) Insofar as the timing of deductions of current R & D expenditures is concerned, none of the countries examined has any provisions more favourable to the conduct of R & D than those in Canada's tax system.

4) Four countries—Canada, the United Kingdom, Denmark, and Hong Kong—allow the immediate write-off of capital expenditures for R & D purposes. All other countries require that the cost of capital assets devoted to R & D be depreciated over their useful lives or some part thereof. Among the countries giving the more generous depreciation allowances are

- Austria—80 per cent in the first year, the balance over the useful life of the asset;
- Korea—50 per cent in the first year, the balance over the useful life of the asset;
- France—on research buildings, 50 per cent in the first year, the balance over the useful life of the building; on research equipment (but only to

Table 5.1 The Tax Treatment of R & D—Canada vs. Major Industrial Countries

		Present value		Tax credits			Allowances			
Country	Corporate income tax, per cent	Current R & D deduction per dollar	Capital cost allowance per dollar	Per cent	Increment or level	Current capital, or both	Per cent	Increment or level	Current capital, or both	Deferrals, years
Canada	46	1	1	10, taxable	Level	Both	50	Increment	Both	Indefinite
United States	46	1	<1	25, nontaxable	Increment	Current and some capital	—	—	—	>5
United Kingdom	52	1	1	—	—	—	—	—	—	5
Germany	56	1	<1	>7.5 nontaxable	Level	Capital	—	—	—	5
France	50	1	<1	—	—	—	10	Level	Some capital	5
Japan	40	1	<1	20 nontaxable	Increment	Current plus depreciation and overhead	[a]	[a]	[a]	5

[a] Also overseas technical export allowance.

Table 5.2—The Tax Treatment of R & D—Canada vs. Small Developed Countries

		Present value		Tax-credits			Allowances			
Country	Corporate income tax, per cent	Current R & D deduction per dollar	Capital cost allowance per dollar	Per cent	Increment or level	Current capital, or both	Per cent	Increment or level	Current capital, or both	Deferrals, years
Canada	46	1	1	10, taxable	Level	Both	50	Increment	Both	Indefinite
Austria	55	1	<1	—	—	—	5	Level	Current	5
Australia	46	1	<1	—	—	—	—	—	—	7
Belgium	48	1	<1	—	—	—	15[a]	Increment	Both	5
Denmark	40	1	1	—	—	—	—	—	—	5
Italy	40	1	<1	—	—	—	—	—	—	4
Norway	50.8	1	<1	—	—	—	—	—	—	10
Spain	33	1	1	10,[b] nontaxable	Level	Both, all must be capitalized	—	—	—	5
Sweden	40	1	<1	—	—	—	16.7	Level	Wages	10
Sweden							20	Increment	Wages	

[a] Increased by 50 per cent to the extent that incremental investment is R & D, also BF 100,000 for each new R & D job created.

[b] Increased to 15 per cent if taxpayer does not reduce number of employees for two years after investment is made.

Table 5.3 The Tax Treatment of R & D—Canada vs. Less-Developed Countries

Country	Corporate income tax, Per cent	Present value		Tax credits			Allowances			Deferrals, years
		Current R & D deduction per dollar	Capital cost allowance per dollar	Per cent	Increment or level	Current capital, or both	Per cent	Increment or level	Current capital, or both	
Canada	40	1	1	10, taxable	Level	Both	50	Increment	Both	Indefinite
Brazil	40	1	<1	—	—	—	—	—	—	4
Hong Kong	16.5	1	1	—	—	—	—	—	—	Indefinite
Korea	40	1	<1	—	—	—	—	—	—	3
Mexico	42	1	<1	20[a]	Level	Capital	—	—	—	3-4
Singapore	40	1	<1	—	—	—	100	Level	Current	Indefinite
Taiwan	35	1	<1	—	—	—	—	—	—	3

[a] Also 10 per cent on sales of technology and 10 per cent for payments for technological services.

firms employing less than 2,000 workers), 50 per cent in the first year, the balance to be depreciated over the useful life of the equipment;

- Belgium—33⅓ per cent per year on 110 per cent of the cost of R & D equipment, with buildings to be depreciated over their useful lives;
- Mexico—35 per cent per year on R & D equipment; and
- Australia—33⅓ per cent per year on buildings and equipment used for R & D.

5) The Canadian tax system provides a present value of the capital cost allowance on assets acquired for R & D purposes that is at least as great as that in any of the other countries examined, and greater than that in 16 of them.

6) With regard to the timing and the flexibility of current deductions and capital cost allowances, the Canadian and Hong Kong tax treatments of R & D are equivalent and they are more generous, often by a considerable margin, than those of the other 18 countries examined.

7) Six countries offer tax credits for R & D: Canada, the United States, Germany, Japan, Mexico, and Spain. Of these, the United States and Japan have based their credits on the *increase* in R & D over a base period, while Canada, Germany, Spain, and Mexico have based their credits on the *level* of R & D spending.

8) Of the credits based on the *level* of R & D spending, Canada's reduces the deductions otherwise available, as does Spain's. In the case of Canada, the credit reduces deductions available dollar for dollar. In Spain, all expenditures must be capitalized in order that a firm may claim the credit. This reduces the present value of the deductions available by an amount that depends on the amortization rate and the discount rate.

9) Again with regard to the credits based on the level of R & D spending, those of Canada and Spain are based on total R & D spending, while Germany's is based only on capital expenditures. When we look at the composite R & D expenditure, which is approximately 10 per cent capital on average, the German tax credit serves to reduce the after-tax cost of a one-dollar R & D expenditure by something more than \$(.10)(.075), or \$.008. The Spanish credit results in no reduction in the after-tax cost of R & D for any declining balance amortization rate below 35 per cent with a 15 per cent discount rate and for any amortization rate over 23 per cent with a 10 per cent discount rate. The essential conclusion is that the Canadian tax credit reduces the after-tax cost of R & D by more than either the German or the Spanish credits.

10) Six countries offer special allowances for R & D: Canada, Austria, Belgium, Sweden, France, and Singapore. Of these, three—Canada, Belgium, and Sweden—offer allowances based on the *increase* in R & D expenditures over some base period. Four countries—Austria, France, Singapore, and Sweden (again)—offer allowances based on the *level* of R & D spending.

11) The allowances based on the level of R & D spending are more properly compared with the Canadian tax credit, which is also based on the level of R & D spending.

- The Austrian allowance is 5 per cent of current R & D spending. For the typical R & D dollar, which is 90 per cent current and 10 per cent capital, and given the Austrian corporate tax rate of 55 per cent, this allowance will reduce the after-tax cost of a typical R & D expenditure by $(.05)(.90)(.55), or $.025. This is less than half the value of the Canadian credit.
- The French allowance applies to R & D equipment only. Even with the generous assumption that the 10 per cent capital component of a given R & D dollar is devoted entirely to equipment, the French allowance would reduce the after-tax cost of a typical one-dollar R & D expenditure by only $(.10)(.10)(.50), or $.005. This is again much less than the effect achieved by the minimum Canadian credit.
- The Singapore allowance applies to current R & D spending only. On a typical R & D dollar it would reduce after-tax cost by $(.40)(.90), or $.36. This is significantly more generous than the maximum Canadian credit.
- The Swedish system has two allowances, one of which is based on the level of the wage component of R & D spending. It works out to 16.7 per cent of the wage component of R & D spending. Assuming that wages and salaries comprise about 60 per cent of the typical R & D dollar, this allowance will reduce the after-tax cost of a typical one-dollar expenditure by $(.40)(.60)(.167), or $.04. This is less than the minimum value of the Canadian credit.

12) Taking together all levels-based R & D credits and allowances offered by all the countries examined, we find that the Singapore special allowance is the most generous, followed by the Canadian credit and the Swedish special allowance. These are followed at a distance by the Austrian special allowance, the German credit, the French special allowance and, depending on the assumptions made regarding the amortization of intangibles, the Spanish credit.

13) Evaluation of the comparative effects of the credits and allowances based on increases in R & D requires that the relevant base periods be defined. They are:

- Canada—the average of the three previous years;
- United States—the average of the three previous years;
- Japan—the previous year;
- Belgium—a three-year average calculated over a period ending three years prior to the tax year; and
- Sweden—the previous year.

Qualifying expenditures differ from country to country as follows:

- Canada—both current and capital;
- United States—Current and relatively little capital;
- Japan—current and most capital;
- Belgium—both current and capital; and
- Sweden—wages and salaries.

Notice then that Canada and Belgium have the most broadly defined bases, while Sweden has the most narrowly defined base.

14) If we assume constant real R & D spending with 10 per cent annual inflation, a 15 per cent rate of interest, and the following fractions of eligible R & D: Canada, 1; United States, .9; Japan, 1; Belgium, 1; and Sweden, .6, the effect on the after-tax cost of a one-dollar R & D expenditure resulting from the credits and allowances listed in (13) above is:

- Canada—$\$(.46)(.50)(.23)+(.46)(.50)(.15)(1-.46) = \$.072$,
- United States—$\$(.25)(.23)(.90)+(.25)(.15)(1-.46)(.90) = \$.070$,
- Japan—$(.20)(.10)+(.20)(.15)(1-.40) = \$.038$,
- Belgium—$\$(.15)(.48)(.51)(1.5)+(.15)(.48)(1.5)(.15)(1-.48) = \$.063$, and
- Sweden—$\$(.20)(.40)(.10)(.60)+(.20)(.40)(.15)(1-.40)(.60) = \$.009$.

15) The allowances and credits based on increases in nominal R & D spending over a moving-average base affect the after-tax cost of R & D and the B-index in two ways. The first effect is that of inflation. The greater the rate of inflation, the greater the rate of increase in nominal R & D spending associated with any given pattern of real R & D expenditures and the greater the allowance or credit for which the taxpayer is eligible. The calculations made in (14) above indicate that for any given rate of inflation, the largest reduction in the after-tax cost of R & D results from the Belgian measure, followed by the United States and Canada, which are similar, and then Japan and Sweden. The second effect is the annual value of the once-for-all tax saving that results from adding one dollar to the firm's annual R & D budget. The magnitude of this effect does not depend on the rate of inflation. For a given rate of interest, the reduction in the after-tax cost of one dollar added to the annual R & D budget is greatest in the cases of the United States, Canada, and Japan, which are virtually indentical, considerably less in the case of Belgium, and still less in the case of Sweden. The joint effect on the after-tax cost of R & D of the annual tax saving due to inflation and the once-for-all tax saving associated with adding another dollar to the annual R & D budget is greatest in the case of Canada, followed closely by the United States and Belgium and distantly by Japan and Sweden.

16) The combined effects of the incentive measures based on both levels and increases will be assessed in the B-index calculations in the following sec-

tion. In general one notes, first, that Canada is one of two countries that maintain incentive arrangements based on both levels of and increases in R & D. Second, the Canadian level-based incentive ranks second and the Canadian increase-based incentive ranks first in terms of the reduction on the after-tax cost of R & D achieved.

17) The Canadian incentives have been in place a relatively long time. The 100 per cent write-off of capital expenditures for R & D has been in place since 1961 and some form of incentive based on incremental R & D spending since 1962. This might be compared with the introduction of R & D incentives by Belgium in 1979 and 1981, by Mexico and Singapore in 1980, and by the United States in 1981.

18) The Canadian incentives are neutral as regards the use of capital and labour in R & D. Both current and capital expenditures are eligible for the special allowance and the credit. This may be contrasted with Germany where the credit is strictly on capital and with Sweden, Belgium, France, and Spain where credits and allowances are tied directly to wage payments and are dependent for their value on the hiring of additional workers.

The B-Index

B-indexes for the countries examined in this study are reported in Table 5.4. These indexes are calculated under two sets of assumptions about the discount rate and the rate of inflation. The first set of assumptions is that the discount rate, r, is 15 per cent and the rate of inflation is 10 per cent. The second set of assumptions is that r is 10 per cent and the rate of inflation 5 per cent.

All firms are assumed to maintain constant real R & D expenditures. Annual nominal R & D expenditures therefore increase at the rate of inflation. As the rate of inflation increases, so does the value of any allowance or credit based on the increase in nominal R & D expenditures, resulting in a lower after-tax cost of R & D and a lower B-index. This is the only way in which inflation affects the B-index.

With the exception of Canada, the United Kingdom, Denmark, and Hong Kong, all countries examined in this study require that the capital component of the R & D expenditures be depreciated over periods in excess of one year. In most cases, depreciation may be by either the straight-line or declining balance method. Except where another method is specified, this study assumes that depreciation is by the straight-line method. In this case, the present value of the deduction allowed (capital cost allowance) on a one-dollar capital expenditure is

$$ZS = 1/T(1-(1/(1+r))^{T})(1+r)/r, \qquad (1)$$

where T is the number of years over which the asset is to be written off. As T or r increases, ZS is reduced. Thus countries requiring that laboratories and equipment be written off over relatively longer periods are effectively reducing the tax saving that a given R & D expenditure can generate. The tax saving is further reduced as the discount rate increases. When facilities and equipment may be written off in the year in which they are acquired, as in Canada, the United Kingdom, Denmark, and Hong Kong, $T = 1$ and $ZS = 1$, and the value of the discount rate, r, does not affect either the after-tax cost of R & D or the B-index.

In a few cases, declining balance depreciation is specified. In these cases the present value of the capital cost allowance on a one-dollar capital expenditure is

$$ZD = D(1+r)/(D+r), \qquad (2)$$

where D is the fraction of the undepreciated cost that may be written off each year. Again, ZD becomes smaller and the after-tax cost of R & D higher as D shrinks and as r increases. If an immediate write-off is allowed, $D = 1$ and $ZD = 1$, and the value of the discount rate, r, does not affect either the after-tax cost of R & D or the B-index.

Capital expenditures account for only a small part of a typical R & D dollar. The data provided in Table 2.2 imply that capital expenditure taken as a whole amounts to approximately 10 per cent of the average R & D dollar. Capital expenditures can themselves be divided equally, albeit roughly, between buildings and equipment. For purposes of the calculation of the B-index then, expenditures on buildings and equipment are each assumed to account for 5 per cent of the R & D dollar. Given these assumptions, a general expression for the B-index can be written as

$$B = (1 - .9t - .05tZSE - .05tZSB - \phi)/(1 - t), \qquad (3)$$

where

t = corporate tax rate,
ZSE = present value of the capital cost allowance on R & D equipment,
ZSB = present value of the capital cost allowance on R & D facilities (buildings), and
ϕ = value of any special allowances or credits for R & D.

Corporate tax rates and the essential features of any special allowances and/or tax credits offered are listed in Tables 5.1 to 5.3. Assumptions regarding the T or D values required to calculate ZSE and ZSB or their declining balance equivalents ZDE and ZDB are as follows:

- For Canada, the United Kingdom, Denmark, and Hong Kong, $T = 1$, so that $ZSE = ZSB = 1$.
- For the United States, T is 3 years for equipment and 15 years for buildings.[1]

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[1] Economic Recovery Act of 1981, Pub. L. No. 97-34, 95 Stat. 14-16, enacted on August 13, 1981.

Table 5.4 The Minimum Benefit-Cost Ratio at Which R & D Is Profitable—Results for 20 Countries, 1981

Country	(1) B, where $r=.15$ $\dot{p}=.10$	(2) Rank	(3) B, where $r=.10$ $\dot{p}=.05$	(4) Rank
1) Canada (10% credit, nonmanufacturing)	0.77	3	0.83	3
2) Canada (20% credit, nonmanufacturing)	0.67	2	0.73	2
3) Canada (10% credit, manufacturing)	0.79	4	0.84	4
4) United States	0.90	6	0.95	7
5) United Kingdom	1.00	11	1.00	10
6) France (>2,000 employees)	1.02	13	1.02	12
7) France (<2,000 employees)	1.02	13	1.01	11
8) Germany (7.5% credit)	1.06	17	1.05	15
9) Germany (10.0% credit)	1.06	17	1.04	14
10) Japan	0.95	9	0.97	9
11) Austria	0.95	9	0.95	7
12) Australia	1.01	12	1.01	11
13) Belgium	0.91	7	0.97	9
14) Denmark	1.00	11	1.00	10
15) Italy	1.03	14	1.03	13
16) Norway	1.05	16	1.04	14
17) Spain (35% depreciation rate)	0.87	5	0.85	5
18) Spain (20% depreciation rate)	0.94	8	0.91	6
19) Sweden	0.95	9	0.95	7
20) Brazil	1.04	15	1.03	13
21) Hong Kong	1.00	11	1.00	10
22) Korea	1.01	12	1.01	11
23) Mexico	0.97	10	0.96	8
24) Singapore	0.41	1	0.41	1
25) Taiwan	1.02	13	1.02	12

Notes: the calculations for each line follow.

Line 1, column 1: $(1-.46-(.46)(.5)(.23)-(.46)(.5)(.15)(1-.46)-.10(1-.46))/(1-.46)$.

Line 1, column 3: $(1-.46-(.46)(.5)(.11)-(.46)(.5)(.10)(1-.46)-.10(1-.46))/(1-.46)$.

Line 2, column 1: $(1-.46-(.46)(.5)(.23)-(.46)(.5)(.15)(1-.46)-.20(1-.46))/(1-.46)$.

Line 2, column 3: $(1-.46-(.46)(.5)(.11)-(.46)(.5)(.10)(1-.46)-.20(1-.46))/(1-.46)$.

Line 3, column 1: $(1-.40-.40(.5)(.23)-(.40)(.50)(.15)(1-.40)-.10(1-.40))/(1-.40)$.

Line 3, column 3: $(1-.40-.40(.5)(.11)-(.40)(.50)(.10)(1-.40)-.10(1-.40))/(1-.40)$.

Line 4, column 1: $(1-(.9)(.46)-(.05)(.46)(.88)-(.05)(.46)(.45)-(.90)(.25)(.23)-(.90)(.25)(.15)(1-.46))/(1-.46)$.

Line 4, column 3: $(1-(.9)(.46)-(.05)(.46)(.91)-(.05)(.46)(.56)-(.90)(.25)(.11)-(.90)(.25)(.10)(1-.46))/(1-.46)$.

Line 5, column 1: $(1-.52)/(1-.52)$.

Line 5, column 3: $(1-.52)/(1-.52)$.

Line 6, column 1: $(1-(.9)(.5)-(.05)(.5)(.77)-(.05)(.5)(.66)-(.05)(.5)(.10))/(1-.5)$.

Line 6, column 3: $(1-(.9)(.5)-(.05)(.5)(.83)-(.05)(.5)(.71)-(.05)(.5)(.10))/(1-.5)$.

Line 7, column 1: $(1-(.9)(.5)-(.05)(.5)(.84)-(.05)(.5)(.66)-(.05)(.5)(.10))/(1-.5)$.

Line 7, column 3: $(1-(.9)(.5)-(.05)(.5)(.88)-(.05)(.5)(.71)-(.05)(.5)(.10))/(1-.5)$.

Line 8, column 1: (1−(.9)(.56)−(.05)(.56)(.58)−(.05)(.56)(.19)−(.075)(.10))/(1−.56).

Line 8, column 3: (1−(.9)(.56)−(.05)(.56)(.68)−(.05)(.56)(.27)−(.075)(.10))/(1−.56).

Line 9, column 1: (1−(.9)(.56)−(.05)(.56)(.58)−(.05)(.56)(.19)−(.10)(.10))/(1−.56).

Line 9, column 3: (1−(.9)(.56)−(.05)(.56)(.68)−(.05)(.56)(.27)−(.10)(.10))/(1−.56).

Line 10, column 1: (1−(.9)(.4)−(.05)(.4)(.82)−(.05)(.4)(.77)−(.20)(.10)−(.20)(.15)(1−.40))/(1−.40).

Line 10, column 3: (1−(.9)(.4)−(.05)(.4)(.87)−(.05)(.4)(.83)−(.20)(.05)−(.20)(.10)(1−.4))/(1−.4).

Line 11, column 1: (1−(.9)(1.05)(.55)−(.1)(.55)(.94))/(1−.55).

Line 11, column 3: (1−(.9)(1.05)(.55)−(.1)(.55)(.96))/(1−.55).

Line 12, column 1: (1−(.9)(.46)−(.1)(.46)(.88))/(1−.46).

Line 12, column 3: (1−(.9)(.46)−(.1)(.46)(.91))/(1−.46).

Line 13, column 1: (1−(.9)(.48)−(.05)(.48)(.96)−(.05)(.48)(.36)−(.48)(.225)(.51)−(.48)(.225)(.15)(1−.48))/(1−.48).

Line 13, column 3: (1−(.9)(.48)−(.05)(.48)(1)−(.05)(.48)(.47)−(.48)(.225)(.23)−(.48)(.225)(.10)(1−.48))/(1−.48).

Line 14, column 1: (1−.4)/(1−.4).

Line 14, column 3: (1−.4)/(1−.4).

Line 15, column 1: (1−(.9)(.4)−(.05)(.4)(.77)−(.05)(.4)(.25))/(1−.4).

Line 15, column 3: (1−(.9)(.4)−(.05)(.4)(.83)−(.05)(.4)(.35))/(1−.4).

Line 16, column 1: (1−(.9)(.51)−(.05)(.51)(.88)−(.05)(.51)(.25))/(1−.51).

Line 16, column 3: (1−(.9)(.51)−(.05)(.51)(.91)−(.05)(.51)(.35))/(1−.51).

Line 17, column 1: (1−(.33)(.81)−.15)/(1−.33).

Line 17, column 3: (1−(.33)(.86)−.15)/(1−.33).

Line 18, column 1: (1−(.33)(.66)−.15)/(1−.33).

Line 18, column 3: (1−(.33)(.73)−.15)/(1−.33).

Line 19, column 1: (1−(.9)(.4)−(.05)(.4)(.88)−(.05)(.4)(.30)−(.6)(.4)(.16)−(.6)(.4)(.2)(.10)−(.6)(.4)(.2)(.15)(1−.4))/(1−.4).

Line 19, column 3: (1−(.9)(.4)−(.05)(.4)(.91)−(.05)(.4)(.40)−(.6)(.4)(.16) −(.6)(.4)(.2)(.05)−(.6)(.4)(.2)(.10)(1−.4))/(1−.4).

Line 20, column 1: (1−(.9)(.4)−(.05)(.4)(.58)−(.05)(.4)(.25))/(1−.4).

Line 20, column 3: (1−(.9)(.4)−(.05)(.4)(.68)−(.05)(.4)(.35))/(1−.4)

Line 21, column 1: (1−.165)/(1−.165).

Line 21, column 3: (1−.165)/(1−.165).

Line 22, column 1: (1−(.9)(.4)−(.1)(.4)(.84))/(1−.4).

Line 22, column 3: (1−(.9)(.4)−(.1)(.4)(.88))/(1−.4).

Line 23, column 1: (1−(.9)(.42)−(.1)(.42)(.81)−(.2)(.1)−(.1)(.08))/(1−.42).

Line 23, column 3: (1−(.9)(.42)−(.1)(.42)(.86)−(.2)(.1)−(.1)(.08))/(1−.42).

Line 24, column 1: (1−(1.8)(.4)−(.1)(.4)(.88))/(1−.4).

Line 24, column 3: (1−(1.8)(.4)−(.1)(.4)(.91))/(1−.4).

Line 25, column 1: (1−(.9)(.35)−(.05)(.35)(.77)−(.05)(.35)(.36))/(1−.35).

Line 25, column 3: (1−(.9)(.35)−(.05)(.35)(.83)−(.05)(.35)(.47))/(1−.35).

- For Germany, T is 10 years for equipment and 40 years for buildings.[2]
- For France, T is 5 years for equipment and 20 years for buildings. The usual Z calculation must be modified to allow for a 50 per cent write-off of R & D buildings in the year they are acquired and, for firms with less than 2,000 employees, a similar 50 per cent write-off for R & D equipment.[3]
- For Japan, T is 4 years for equipment and 5 years for buildings.[4]
- For Australia and Singapore, T is 3 years for both equipment and buildings.[5]
- For Austria, T is 5 years for both buildings and equipment, with 80 per cent of the cost to be written off the first year and the remaining 20 per cent over the next 4 years.[6]
- For Belgium, T is 3 years for equipment and 20 years for buildings. Taxpayers may write off 110 per cent of the cost of equipment.[7]
- For Italy, T is 5 years for equipment and 30 years for buildings.[8]
- For Norway, T is 3 years for equipment and 30 years for buildings.[9]
- Spain requires that all R & D be capitalized if the R & D tax credit is to be claimed. The *maximum* period over which intangible assets may be written off is 10 years.[10] This implies a minimum declining balance depreciation rate of 20 per cent. We have assumed a maximum rate of 35 per cent and have calculated Z for both the minimum and the maximum rates.
- For Sweden, T is 3 years for equipment and 25 years for buildings. Special allowances relate only to wage payments and are weighted by .6, the fraction of the average R & D dollar allocated to wages.[11]
- For Mexico, the maximum declining balance depreciation rate, D, is 35 per cent for both equipment and buildings.
- For Korea, 50 per cent of both R & D buildings and equipment may be

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[2] International Bureau of Fiscal Documentation, *The Taxation of Companies in Europe* (Amsterdam: the Bureau) (looseleaf service), paragraphs 188-91 and 196.

[3] Ibid., paragraph 387; Francois Lefebvre, "France: New Tax Incentives for Investments," September 1979 *Tax Management International Journal* 23-23 and 27, at 23 and 27.

[4] National Science Foundation, *Corporation Income Tax Treatment of Investment and Innovation Activities in Six Countries*, PRA Research Report 81-1 (Washington, D.C.: National Science Foundation, 1981), 101.

[5] E. F. Mannix and J. E. Mannix, *Australian Income Tax Guide* (Sydney: Butterworths, 1981), paragraph 1351; James Chia Shih Ching "Singapore: A 1980 Income Tax Act (Amendment No. 2)," January 1981 *Tax Management International Journal* 34-35, at 34.

[6] Supra footnote 2, at paragraphs 133 and 133a.

[7] Ibid., at paragraphs 155 and 158.

[8] United Kingdom, Board of Inland Revenue, *Income Taxes Outside the United Kingdom: Italy 1975-1977* (London: HMSO, 1978), paragraph 20(7); Charles K. Cobb Jr. and Francesco Forte, *Taxation in Italy*, World Tax Series (Chicago: CCH, 1964), 418-19.

[9] Supra footnote 2, at paragraphs 183 and 185.

[10] Ibid., at paragraph 255a.

[11] See Table 2.2; supra footnote 2, at paragraphs 206, 207, and 216.

written off in the year of acquisition with the balance over the succeeding 5 years.[12]

- For Taiwan, T is 5 years for equipment and 20 years for buildings.[13]
- For Brazil, T values of 10 years and 30 years for equipment and buildings respectively were assumed in the absence of any information regarding statutory T values.

The above assumptions must be regarded as best guesses. They are the net result of the application of accelerated depreciation provisions offered by most countries to their "normal" capital cost allowances. The latter are often expressed as ranges of D or T values. This study has taken the top D or bottom T in these ranges. In general, it has calculated the highest Z value for both equipment and buildings that is obtainable under each national tax system. As the following discussion will show, this biases the comparison of B-indexes against Canada.

Examination of the B-indexes reported in Table 5.4 and their ranking indicates that apart from Singapore, which has had its special allowance in place only since 1980, the tax system of Canada provides a greater incentive to engage in R & D than does the tax system of any of the other countries we have discussed. Canada's rank as the second most favourable tax environment for R & D is not particularly sensitive to the assumptions that are made regarding the discount rate, the inflation rate, and the capital cost allowance provisions of the countries examined. There are several reasons for this. First, the Canadian B-index is substantially lower than that of all other countries except Singapore and, under, some rather tenuous assumptions, Spain. It would take a significant change in relative B values to alter this.

Second, since capital expenditures may be written off immediately in Canada, its B-index does not depend on the discount rate assumed. Other things being equal, for any positive discount rate, the after-tax cost of R & D in Canada will be lower than in countries not allowing immediate write-offs.

Third, Canada offers a tax credit based on *all* R & D expenditures and a special allowance based on the increase in the nominal value of *all* R & D expenditures and it is the only country of the group we have examined to do so. As a consequence, the after-tax cost of R & D and the B-index for Canada fall relative to countries that do not offer credits or allowances based on nominal increases in R & D, as the assumed rate of inflation rises. As the assumed rate of inflation decreases, the after-tax cost of R & D and the B-index for Canada rise in absolute terms but fall relative to countries offering *only* incentives based on increases in nominal R & D spending.

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[12] Deloitte Haskins and Sells, International Tax Service, *Taxation in Korea* (New York: Deloitte Haskins and Sells, 1981), paragraph 7.02.

[13] Deloitte Haskins and Sells, International Tax Service, *Taxation in Taiwan, ROC (Republic of China)* (New York: Deloitte, Haskins and Sells, 1981), paragraph 2.05.

A comparison of the B-indexes for Canada, the United States, and Belgium illustrates this point for rates of inflation at 5 and 10 per cent. The relatively low B values of both the United States and Belgium are due to a tax credit in the United States and to an allowance in Belgium that, given constant real R & D expenditures, are increasing functions of the assumed rate of inflation. With a 10 per cent rate of inflation, Canadiah and U.S. firms are able to report annual increases in R & D of 23 per cent over their calculation bases, while Belgian firms would experience 51 per cent increases under the same circumstances.

If the assumed rate of inflation is 5 per cent, the annual increase in R & D expenditures over the calculation base is 11 per cent in Canada and the United States and 23 per cent in Belgium. The B-indexes in all three countries rise. The rank of the United States falls from sixth to eighth and Belgium falls from seventh to ninth. Canada continues to occupy the second, third, and fourth positions. The reason is that, unlike the United States and Belgium, Canada also offers a credit based on the *level* of R & D spending. The tax saving this credit implies does not depend on the assumed rate of inflation.

Finally, while a number of countries offer special allowances or credits that appear more generous than those offered by Canada, most apply only to a small portion of the R & D dollar. The Swedish special allowances apply only to the level of and the change in the R & D wage bill, which is 60 per cent of the R & D dollar. The French allowance applies only to R & D buildings (for firms with more than 2,000 employees) and the German credit applies only to buildings and equipment. Spain offers a credit based on the total R & D outlay but makes this credit conditional on the capitalization of the entire expenditure.

In sum, Canada's tax treatment of R & D remains relatively favourable under a wide range of assumptions because it offers the taxpayer a variety of broadly based benefits. The aggregate value of these benefits is not sensitive to the parameters assumed in the analysis.

While these inferences regarding the relative position of Canada are unequivocal, it would be unwise to read too much into the ranking of a number of other countries. Given the range of possible values of the capital cost allowance in each country, one should not infer from the B-indexes in Table 5.4 that the Korean and Australian tax systems provide the same incentive to engage in R & D or that both countries provide more incentive for R & D than does France.

Some restricted comparisons are possible. For example, it appears that when the United Kingdom, France, and Germany are compared, the tax treatment of R & D is most favourable in the United Kingdom, followed by France and then, at a distance, by Germany. The reason is that the United Kingdom offers an immediate write-off of R & D capital, whereas France offers a 50 per cent initial write-off of R & D buildings combined with a tax credit on R & D buildings. Germany apparently offers no accelerated depreciation whatsoever (except in Berlin and other areas contiguous to the GDR) and its tax credit on R & D capital is insufficient to compensate for this.

The tax treatment of R & D is more favourable in Sweden and Austria than in the three major European countries. In the Austrian case, the difference is due to a 5 per cent special allowance on current R & D expenditures and an 80 per cent initial write-off of R & D capital. In the Swedish (1981) case, the advantage derives from special allowances equal to 16.7 per cent of the R & D wage bill and 20 per cent of the increase in the R & D wage bill respectively along with a three-year write-off of R & D equipment.

The position of the United States vis-à-vis the major European countries depends very much on what is assumed regarding the nominal growth of R & D expenditures. Given constant real R & D expenditures and high rates of inflation, the new U.S. tax credit drives the B-index down significantly. If there were no growth in nominal R & D and, say, a 10 per cent rate of interest, however, the U.S. B-index would be 1.00, below that of France and about the same as that of the United Kingdom.

Other comparisons are obviously possible. Expressions for all the B-indexes reported in Table 5.4 are included in the notes to that table. The reader may employ these expressions as well as the expressions for ZSE and ZSB to determine the source of the differences in the reported B-indexes and to evaluate the consequences of alternative assumptions regarding the present value of the capital cost allowance available in each country.

6

Other Types of Government Support of R & D

Insofar as the tax system itself is concerned, the R & D incentives offered by Canada are superior to those in all but one of the 20 countries examined. The one country with more generous incentives is Singapore, and its incentive, a 200 per cent write-off, has been in effect for a little over a year. It may be the case, however, that when it is argued that Canada does not offer sufficient incentives for R & D, the term "incentive" applies to the full range of tax, subsidy, and contracting policies of the national government. This study, therefore, attempts to determine the R & D subsidy and R & D contract policies of a subset of the countries listed in Table 5.4, and then investigates whether the amount of support provided to industrial R & D by these subsidies and contracts would be sufficient to change the ranking of the B-indexes in the table.

Ideally, subsidies and contracts should be separated. They are not equivalent. A subsidy is a payment for which the government expects nothing directly in return. The replacement of a dollar of private R & D expenditure with a dollar of subsidy reduces the after-tax cost of R & D from \$.41, in the low-credit Canadian case, to zero. If the project requires a 50 per cent sharing of costs between the firm and the government, as Canadian R & D subsidy programs have historically done, the after-tax cost of a one-dollar project falls from \$.41 to \$.21. In the case of the 100 per cent subsidy, the B-index falls from .77 to zero. In the case of the 50 per cent subsidy, the B-index falls from .77 to .39.

A contract is something quite different. It is a purchase of R & D by the government from the firm. The purchase price reflects the cost in terms of wages, materials, and overhead of conducting the R & D. This does not constitute support in the same sense as an R & D subsidy. Indeed, it does not constitute support of R & D any more than a government contract to produce pencils constitutes support or subsidization of the pencil industry.

There may be an element of support in an R & D contract. The contractor may be paid the full cost of producing information he can use elsewhere. To the extent that the R & D paid for by the government can generate other income for the contractor—that is, to the extent that there are spin-off benefits—an R & D contract constitutes support of R & D. One must be very careful about claiming that there are spin-off benefits and that they will constitute a subsidy to the contractor. If R & D contracts are subject to competitive bidding, as they often are in the United States and sometimes in Canada, spin-off benefits will be bid away. That is, if there are advantages that can be gained from the contract, the value of these advantages will be reflected in the bids of potential contractors and the winning bid will be lower.[1] The spin-off benefit, hence the subsidy element, of the contract will be bid away and R & D contracts will not constitute "support" of R & D.

If contracts are of a sole-source variety, it may be that the contractor can negotiate a price that preserves an element of subsidy. Even here the outcome is ambiguous. There is no exclusive right to become a sole-source contractor. A firm puts itself in a position to become a sole-source contractor by the expenditure of resources to build up a unique research capability. It might be argued that the *ex ante* gains from being a sole-source contractor will already have been swallowed up by the costs of becoming one. Again, the subsidy element will be relatively small if it exists at all.

For the sake of argument, let us concede that spin-off benefits exist and that they are not bid away or dissipated by potential contractors. Will we observe R & D contracts that are 100 per cent subsidy? We would argue that R & D contracts with a subsidy element equal to the value of the contract will never be observed. Suppose the subsidy element is equal to the cost of performing the required R & D. The implication is that the expected spin-off income of the contractor (the subsidy element) is equal to the cost of performing the R & D required under the contract. If this were the case, however, the contractor would have been able to recover his costs on his own and performance of the R & D would not be contingent on the receipt of a government contract. Thus any time a government contract is a necessary condition for having research performed, the value of the spin-off benefits must be less than the value of the contract. For contracts that increase rather than simply redistribute the cost of R & D, at least, the subsidy element must be less than the value of the contract.

These theoretical arguments notwithstanding, the exact magnitude of the subsidy element in an R & D contract remains an empirical question. Two recent U.S. studies have concluded that the magnitude of spin-off benefits, hence the subsidy element, is very small indeed. Goldberg[2] found that spin-off benefits accruing to recipients of federal R & D contracts in the United

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[1] W. D. Collins and J. A. Ferejohn, "Patent Provisions in Federal R & D Contract Policy," in *Government Policies and Technological Innovation*, Vol. III, Study No. PB-244 573 (Washington, D.C.: National Science Foundation, 1975), 146-69.

[2] Lawrence Goldberg, *The Influence of Federal R & D Funding on the Demand for and Returns to Industrial R & D*, Report no. NSF/PRA-7722919 (Washington, D.C.: National Science Foundation, October 1979).

States have amounted to 2 per cent of the value of the contract. Terleckyj[3] found that federally funded R & D had either no effect or a negative effect on the subsequent growth in total factor productivity of U.S. R & D contractors. The implication of Terleckyj's work is that spin-off benefits are non-existent.

Both the theoretical arguments and the available empirical work imply that tax incentives, subsidies, and contracts cannot be compared on an equal footing. If contracts are given any weight at all, it should be a small fraction of contract values. In the analysis that follows we assume that the subsidy element in an R & D contract is either 20 or 50 per cent of the value of the contract. This assumption will overstate, if anything, the extent of government support for industrial R & D inherent in an R & D contract.

Subsidies

Relatively few countries keep separate records of their R & D subsidy payments. Some evidence is available from Canada, Germany, Australia, Belgium, and Japan, and this is reported in Table 6.1. As the table indicates, Canadian R & D subsidies account for at least as high a proportion of its industrial R & D as do subsidies in the other countries for which data could be obtained. The introduction of subsidy data into the calculation of the B-index would not change Canada's number one ranking. Indeed, it would reduce Canada's B-index relative to that of all other countries except Australia. The latter would improve its ranking relative to all other countries except Canada. The relative positions of Canada and Australia would remain unchanged.

Contracts and Their Impact on the B-Index

A number of countries report R & D contracts and subsidies (if any) together. The fraction of industrial R & D accounted for by contracts and subsidies in all countries for which the combined figure was available is reported in Table 6.2. As the table indicates, a very large fraction of industrial R & D in the United States, the United Kingdom, and France is conducted under contract. It is also the case, however, that the U.S. 35 per cent under-contract figure is *not* equivalent to 35 per cent subsidy or tax credit.

Let us begin with the assumption that 20 per cent of an R & D contract is a subsidy. We further assume that in the case of countries for which subsidy data are not available all "direct support" listed in column 1 of Table 6.2 is in the form of contracts. Under these assumptions the percentage of industrial

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[3] Nester E. Terleckyj, "Direct and Indirect Effects of Industrial Research and Development on the Productivity Growth of Industries," in John W. Kendrick and Beatrice N. Vaccara, eds., *New Developments in Productivity Measurement and Analysis*, Studies in Income and Wealth, Vol. 44 (Chicago: University of Chicago Press, 1980), 359-77.

Table 6.1 Government Subsidies as a Percentage of Industrial R & D Spending—P(S)

Country	Year	Per cent
Canada	1979	9.4
	1980	9.5
	1981	9.4
Germany	1977	6.7
Australia	1978-79	9.5
Belgium	1977	3.6
Japan	1977-78	1.9

Sources: Canada—Ministry of State for Science and Technology, *Federal Science Activities 1981/1982* (Ottawa: Department of Supplies and Services, 1981), 50; Statistics Canada, (1981) 5, no. 8 *Science Statistics* 3.

Germany—Federal Republic of Germany, *Sixth Report of the Federal Government on Research* (Bonn: the Federal Minister for Research and Technology, Press and Public Relations Division, 1980), 84-85.

Belgium—Belgian Embassy, "Aide gouvernementale à la R-D industrielle en Belgique" (mimeograph, Ottawa); Belgium, Services du Premier Ministre, *Les incitants a l'innovation technologique* (Bruxelles: Programmation de la Politique Scientifique, Fevrier 1981).

Australia—Bureau of Statistics, *Year Book Australia 1981* (Canberra: Government Printer, 1981), 672; Australia, Committee of Inquiry into Technological Change in Australia, *Technological Change in Australia*, Selected Papers on Technological Change, Vol. 3 (Canberra: Government Publishing Service, 1980), 51-52.

Japan—Organisation of Economic Cooperation and Development, *Science Resources Newsletter*, no. 5 (Paris: OECD, 1980), 15; Japan, Planning Bureau, Science and Technology Agency, *Outline of the White Paper on Science and Technology*, December 1977, (unofficial translation released by the Foreign Press Centre, February 1978).

R & D covered by subsidy or subsidy equivalent in the ith country can be written as

$$P^*(S)_i = P(S)_i + .2(P(S+C)_i - P(S)_i), \tag{1}$$

where

$P(S)_i$ = the proportion of industrial R & D in the ith country covered by subsidies, as reported in Table 6.1,

= 0 if the ith country does not report R & D subsidies, and

$P(S+C)_i$ = the proportion of the industrial R & D in the ith country covered by subsidies and contracts as reported in column 1 of Table 6.2.

Given $P^*(S)$, the value of which is reported in column 2 of Table 6.2, the B-indexes reported in Table 5.4 can be recalculated. Since the before-tax income necessary to cover one dollar of subsidized R & D is zero, the B-index will be a decreasing function of the fraction of R & D covered by subsidies. Specifically,

$$B^* = B(1-P^*(S)). \tag{2}$$

B* values calculated in this manner are reported in column 3 of Table 6.2. As the ranking given in column 4 of Table 6.2 indicates, taking account of the fraction of R & D supported by subsidy does not change Canada's position

Table 6.2 Subsidies, The Subsidy Element in Contracts, and the B-Index in 12 Countries

Country and year	(1) Subsidies and contracts as a % of industrial R & D $P(S+C)$	(2) Subsidies as a % of industrial R & D if contracts are 20% subsidy $P^*(S)$[a]	(3) B^* ($r=.15$ $\dot{p}=.10$)[b]	(4) B^* Rank	(5) Subsidies as a % of industrial R & D if contracts are 50% subsidy $P^*(S)$[c]	(6) B^* ($r=.15$ $p=.10$)[d]	(7) B^* Rank
Australia, 1976/77	4.9	9.5[e]	0.91	4	9.5	0.91	7
Canada, 1977/78[f]	11.6	9.8[g]	0.69	1	10.5	0.69	1
	11.6	9.8	0.71	1	10.5	0.71	1
Denmark, 1976/77	8.2	1.6	0.98	9	4.1	0.96	10
France, 1977	25.2	5.1	0.97	8	12.6	0.89	6
Germany, 1977	15.9	8.6	0.97	8	11.3	0.94	9
Italy, 1977	11.0	2.2	1.01	10	5.5	0.97	11
Japan, 1977/78	1.9	1.9	0.93	6	1.9	0.93	8
Sweden, 1977/78	15.3	3.1	0.92	5	7.7	0.88	5
Belgium, 1975	8.0	4.5	0.87	3	5.8	0.86	4
Austria, 1972	4.0	0.8	0.94	7	2.0	0.93	7
United Kingdom, 1975	31.0	6.2	0.94	7	15.5	0.85	3
United States, 1977	35.2	7.0	0.84	2	17.6	0.74	2

[a] $P^*(S) = P(S)+.2(P(C+S)-P(S))$, where $P(S)$ is as reported in Table 6.1, zero otherwise.

[b] $B^* = B(1-P^*(S))$, where B is as reported in column (1), Table 5.4.

[c] $P^*(S) = P(S)+.5(P(C+S)-P(S))$, where $P(S)$ is as reported in Table 6.1, zero otherwise.

[d] $B^* = B(1-P(S))$, where B is as reported in column (1), Table 5.4.

[e] $P^*(S)$ for Australia is taken as 9.5 per cent; see Table 6.1.

[f] The figures in the upper row represent 10 per cent R & D tax credit, 46 per cent corporate tax rate; the figures in the lower row represent 10 per cent R & D tax credit, 40 per cent corporate tax rate.

[g] $P(S)$ for Canada is taken to be 9.4 per cent.

Source of values in column 1: Organisation of Economic Cooperation and Development, *Science Resources Newsletter*, no. 4 (Paris: OECD, 1979), 2, and no. 5 (1980), 14-15.

vis-à-vis the rest of the world. Of the countries for which subsidy and/or contract data are available, Canada offers the most generous incentives for R & D.

It may be the case that the subsidy element in an R & D contract is somewhat greater, say, 50 per cent. In this case $P^*(S)_i$ would be

$$P^*(S)_i = P(S)_i + .5(P(S+C)_i - P(S)_i), \tag{3}$$

where all the variables are as defined previously. $P^*(S)$ values calculated under the assumption that R & D contracts are 50 per cent subsidy are reported in column 5 of Table 6.2. The B^* values they imply are reported in column 6.

As the B^* ranking reported in column 7 of Table 6.2 indicates, Canada retains its position as the nation providing the most favourable environment for R & D. That is, when the tax system, subsidy programs, and R & D contracts are taken into account and when R & D contracts are assumed to be 50 per cent subsidy, Canada provides a greater incentive to engage in R & D than does any of the other 11 countries for which these kind of data were available.

While Canada's ranking is not changed, the increase in the weight attached to R & D contracts does change the relative positions of some of the other countries examined. When contracts are assumed to be 50 per cent subsidy, the ranks of Britain and France, both of which make extensive use of R & D contracts, change from seventh to third, and from eighth to sixth respectively. Japan, which offers relatively generous tax treatment of R & D, makes little use of subsidies or contracts and, as a consequence, slips toward the lower end of the ranking.

While we consider the possibility to be remote, it is conceivable that an R & D contract could be regarded as equivalent dollar for dollar with a subsidy or a tax reduction. We must concede that in this case the ranking of the B-indexes would change but not drastically. The United States would have a B-index of 0.58, the United Kingdom 0.69, France 0.78, and Germany 0.89 as compared with Canada's 0.68 for nonmanufacturing and 0.70 for manufacturing. Thus Canada would slip to second, well behind the United States and close to the United Kingdom, among the countries for which data are available. Our point is, however, that contracts and tax reductions are not equivalent dollar for dollar and that the argument that Canada match R & D contract dollars with tax expenditure dollars on an equal basis is highly misleading.

7

The Adequacy of Canadian R & D Incentives: Applying an Absolute Standard

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So far, this analysis has been conducted in relative terms and indicates that, relative to other countries, Canada maintains a very favourable tax and tax-subsidy environment for R & D. The question remains, however, whether the Canadian environment is sufficiently generous by some absolute standard.

A tax-subsidy system can be considered allocatively efficient if it equates the social and private returns on R & D at the margin. More simply, tax incentives and subsidies are adequate in absolute terms if they are sufficient to induce firms to conduct all R & D projects with social benefit-cost ratios of 1 or greater. Whether Canadian and tax subsidy treatment of R & D is adequate in absolute terms, then, depends on the ratio of the social to the private returns on R & D and on the B-index for R & D.

To take a simple example, suppose we know that the social benefit-cost ratio on R & D is twice the private benefit-cost ratio and that the B-index is .50. In this case, firms would find it profitable to engage in any R & D projects with private benefit-cost ratios in excess of .50. In so doing they would be undertaking any R & D project with a social benefit-cost ratio in excess of 1 (that is, 2 × .50).

Applying the results obtained in Chapter 6 (Table 6.2), one finds that the tax and subsidy systems together result in a B-index of .71 for a large, non-Atlantic-region manufacturing firm. This implies that a firm with these characteristics will expand its continuing, constant dollar R & D expenditures to the point at which the private benefit-cost ratio on the last dollar spent is .71. If the social benefit-cost ratio is anything less than 1/.71, or 1.41 times the private benefit-cost ratio at the margin, the Canadian R & D tax-subsidy environment is sufficiently generous in the sense that all R & D projects with social benefit-cost ratios greater than 1 will be undertaken.

To put this proposition in more general terms, suppose the social benefit-cost ratio is e times the private benefit-cost ratio, where e is greater than 1 and e-1 represents what economists would call the R & D externality. Thus

$$MSBC = eMBC. \qquad (1)$$

Under ideal circumstances, Canada would continue to allocate resources to R & D until the social benefit-cost ratio on the marginal R & D dollar is 1—that is, until the present value of the benefits produced by the last R & D dollar is $1. Thus sufficient resources are allocated to R & D when

$$MSBC = 1. \tag{2}$$

Finally, individual firms will allocate resources to R & D until the private benefit-cost ratio on the marginal R & D dollar equals the B-index. Thus, maximization of profits by individual firms requires that

$$MBC = B. \tag{3}$$

Substituting (2) and (3) into (1) yields the condition that must hold if the tax-subsidy system is such that sufficient resources are being allocated to R & D. Thus Canada's R & D incentives are sufficiently generous in absolute terms if

$$B = 1/e. \tag{4}$$

Expression (4) can be used in two ways. If we know e, then we know the required B-index. If we don't know e but we do know B, we can calculate the e values for which the observed B implies that Canada's incentives are sufficiently generous. The example given at the beginning of this chapter takes this approach, concluding that Canada's R & D incentives are sufficiently generous provided e is less than 1.41.

Of course, the same calculation could be made on the basis of the B-index of a firm with different characteristics. We know, for example, from Table 3.3, that the B-index for a large, nonmanufacturing Atlantic-region firm is .667. Adding subsidies in the manner suggested in Table 6.2 and assuming that contracts have a 20 per cent subsidy element yields a subsidy-inclusive B-index of $.67(1-.098)$, or .60. If the social benefit-cost ratio on the marginal R & D dollar is anything less than 1/.60—that is, 1.67—times the private benefit-cost ratio, Canadian incentives are sufficient. That is, for e less than 1.67, Canadian incentives are sufficient.

To take the other approach, we need an estimate of e. The best estimates of e have been made by Mansfield et al.[1] An analysis of a relatively small set of major U.S. R & D projects undertaken during the 1960's led these authors to conclude that the equivalent of the social benefit-cost ratio was between 1.77 and 2.50 times the private benefit-cost ratio.[2] It should be emphasized that these were major R & D projects. The externality may be somewhat smaller on marginal R & D projects.

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[1] Edwin Mansfield, John Rapoport, Anthony Romeo, Edmond Villani, Samuel Wagner, and Frank Husic, *The Production and Application of New Industrial Technology* (New York: Norton, 1977).

[2] Ibid., at 157-64.

If e is assumed to be 1.77, then if all R & D projects with social benefit-cost ratios in excess of 1 are to be undertaken, the B-index must be 1/1.77, or .56. Thus, what little evidence there is on the value of e indicates that, while Canada's tax treatment of R & D is generous by international standards, it may not be sufficiently generous to offset the effect of the inappropriability of the returns on R & D.

The foregoing has assumed implicitly that all other investment activities are being carried to the point at which the social benefit-cost ratio on the marginal dollar spent is 1. That is, the only imperfection in the economy is the partial inappropriability of part of the return on R & D. In this case, the task of the tax-subsidy system is simple. It is to reduce the B-index to the point at which all R & D with a social benefit-cost ratio of 1 or greater is undertaken.

Suppose, however, that alternative investment activities are not pushed to the point at which their social benefit-cost ratio is 1. Suppose the marginal social benefit-cost ratio of a representative alternative investment is 1.10. In this case, the efficient allocation of resources between R & D and the alternative investment requires that social benefit-cost ratios be equalized at the margin—in this case, at 1.10. The task of the R & D tax-subsidy system is to lead firms to engage in R & D to the point at which the marginal dollar spent has a social benefit-cost ratio of 1.10. The B-index required to achieve this will be higher (and the incentives less generous) than under our previous assumptions.

In more formal terms, efficient allocation of resources between R & D (R) and a representative alternative investment (A) implies that

$$MSBC_A = MSBC_R. \tag{5}$$

If the entire return on the alternative investment is appropriable, then the latter will be pushed to the point at which

$$B_A = MBC_A = MSBC_A. \tag{6}$$

Substituting equations (1) and (3) (with an R subscript attached) and (6) into (5) yields an expression for a B-index on R & D that efficiently allocates resources between R & D and alternative investment activities. Social benefit-cost ratios will be equalized at the margin if

$$B_R = B_A/e. \tag{7}$$

To find B_R, we must know B_A. Earlier the B-index was found for a representative alternative investment in plant and equipment.[3] The alternative was assumed to involve 70 per cent machinery and equipment and 30 per cent buildings and structures. The firm involved was assumed to be a large manufacturing firm located outside the Atlantic region. Under these assumptions, the B-index was found to be 1.06.

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[3] See Chapter 3 under the heading "The Impact of the Tax System. . . ."

As Table 6.2 shows, the subsidy-inclusive B-index for an R & D investment by the same firm is .71. These two B-indexes imply that if e is anything less than 1.06/.71, or 1.49, the R & D tax subsidy environment is sufficiently generous. In this context, "sufficiently generous" implies that any R & D project with a social benefit-cost ratio in excess of that on an average investment in physical capital will be undertaken.

Recalling that Mansfield et al.[4] estimated that e was between 1.77 and 2.50 and that these estimates might be excessive as far as all R & D activities are concerned, the conclusion can be drawn that in absolute terms the tax treatment of R & D may not be sufficiently generous to offset the R & D externality. While this analysis could be conducted under a number of different assumptions about the nature of the alternative investment, its tax-subsidy treatment, and the extent of the externality associated with it, this general conclusion seems likely to continue to hold.

8

The Impact of R & D Incentives on R & D Spending

Policy-makers may be interested in the magnitude of the wealth transfer required to induce a given increase in R & D spending. The ultimate purpose of collecting this type of information is to design a tax-subsidy regime that minimizes the annual wealth transfer associated with the maintenance of a given level of R & D spending. This study allows some limited comments on this issue. If one is prepared to make some assumptions regarding the elasticity of the MBC schedule, one can estimate the amount by which R & D spending would fall if R & D were treated the same for tax purposes as a representative alternative investment in physical capital.

Earlier, the B-index for an average investment in plant and equipment was calculated to be 1.06. The firm involved was assumed to be a large manufacturing firm located outside the Atlantic region. As Table 3.3 shows, the B-index for the same firm contemplating an R & D investment would be .79. Thus the special tax treatment of R & D has resulted in a B-index that is lower by (1.06−.79)/1.06, or 25.5 per cent, than the B-index for an investment in plant and equipment. Annual R & D spending will be greater if the B-index is .79 than if it is 1.06 (see Figure 8.1). The more elastic the MBC schedule is, the greater the amount by which R & D will increase.

There is very little information available on the elasticity of the MBC schedule or, more generally, on the price elasticity of demand for a stock of knowledge. Some highly tentative estimates have been made by Nadiri,[1] who found that the equivalent of the elasticity of the MBC schedule could be as high as .60. This would imply that observed annual R & D spending is (25.5)(.60), or 15.3 per cent higher than it would have been if R & D were treated the same for tax purposes as an investment in plant and equipment. In this case, 1981 R & D spending by manufacturing firms would have been $1,310 million rather than the $1,510 million that was actually observed (see Table 2.1).

Insofar as the tax expenditure required to facilitate this additional R & D is concerned, we know that the R & D incentives have had the effect of reducing

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[1] M. Ishaq Nadiri, "Contributions and Determinants of Research and Development Expenditures in the U.S. Manufacturing Industries," in George M. von Furstenberg, ed., *Capital, Efficiency and Growth* (Cambridge, Massachusetts: Ballinger, 1980), Chapter 5, at 386-88.

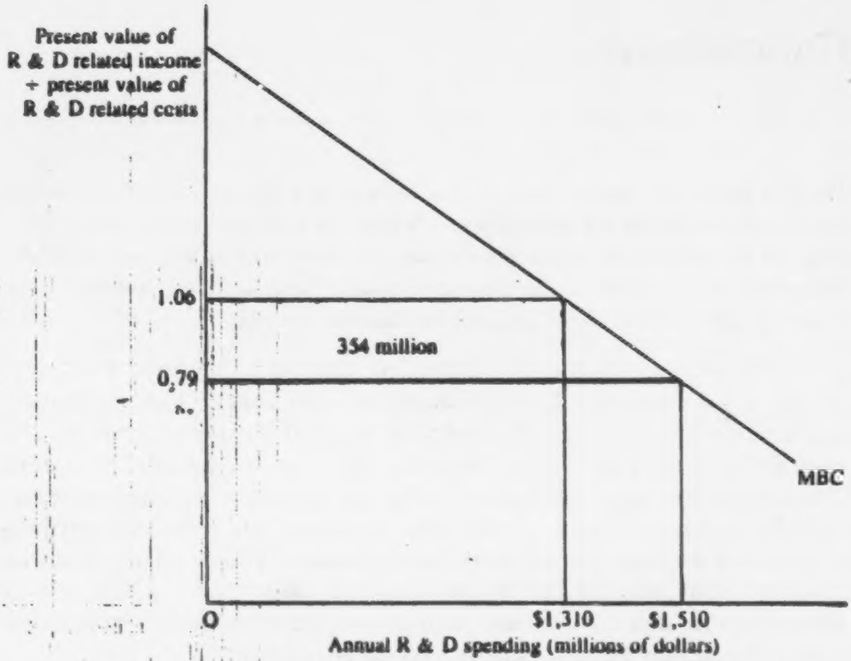

Figure 8.1 The Effect of Preferential Tax Treatment of R & D

the B-index from 1.06 to .79. That is, they have reduced the benefit-cost ratio at which R & D would become profitable by 27 percentage points. These incentives must therefore have had a present value of (1.06 − .79), or $.27 per dollar spent on R & D. The tax expenditure associated with the R & D incentive package must therefore be (.27)($1,310), or $354 million per year. This is revenue the government would have collected had it required that R & D be treated the same for tax purposes as an average investment in plant and equipment. The government forgoes this $354 million annually in tax revenue in order to induce (1510 − 1310), or $200 million in additional annual R & D spending. The induced R & D spending is less than the tax revenue forgone. This will always be the case, however, as long as the elasticity of the MBC schedule is less than 1.

These results are highly tentative and are intended principally to suggest a path for future research. Better estimates of the elasticity of the MBC schedule are required. Moreover, if the model introduced in Chapter 2[2] has any validity, one should distinguish between country-specific and footloose R & D when estimating the impact of changes in the B-index.

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[2] See Chapter 2 under the heading "The Economic Implications of International Differences in the B-Index."

9

Conclusions

While Canada has been using its tax system to encourage R & D for some time, other countries are generally just beginning to do so. At this time, Canadian tax incentives are as generous as any we have been able to find with the exception of Singapore's. The situation is quite fluid, however, and will have to be monitored more closely than it has been in the past.

Taking all R & D incentives together, the fraction of industrial R & D supported by *subsidies* is as high in Canada as in any country that was investigated. Relatively little Canadian industrial R & D is done under contract. If a contract is taken as equivalent, dollar for dollar, with a subsidy, the United States would rank next to Singapore as the most generous in its aggregate tax-subsidy treatment of R & D. If the subsidy element of a contract is anything less than 65 per cent, Canada would retain its second place ranking among all countries examined and first place among all countries for which subsidy and/or contract data are available. In our view, the subsidy element in a contract will generally be much less than 65 per cent.

As we indicated in the introduction, this study has the clear but limited goal of comparing the R & D incentives provided by Canada with those of other countries. Under reasonable assumptions, the incentives in place in Canada, whether narrowly or relatively broadly defined, are among the most generous if not the most generous we have been able to find.

Two questions arise. First, conventional wisdom has it that the Japanese government provides powerful assistance to Japanese firms, especially in the high technology field. Yet, in terms of its B-index either narrowly or broadly defined, Japan ranks well behind Canada. What does this say? It says that, in terms of formal tax measures, R & D subsidies, and contracts, Japan does not provide a great deal of support for domestic R & D by international standards. Unless we have missed some of the relevant programs, Japanese government support for domestic high technology firms must, to the extent that it exists, be conveyed to the latter by other means such as tariff and purchasing policy and through the capital market. It appears that in the Japanese, the German, and, to a certain extent, the French cases, if domestic firms are receiving a high level of support, it is not coming through the channels examined in this study.

Second, if Canada has been an innovator in the past as far as its policies toward R & D are concerned, why should it not be an innovator in the future? Canada should not be held back from providing more government support for industrial R & D by the mere fact that it is already providing more support than most, if not all, countries.

In response, it must be conceded that the R & D incentives of all countries, not excluding Canada, may be inadequate. We have investigated this possibility and have come to the conclusion that the R & D incentives presently in place are sufficient to offset an R & D externality of something over 40 per cent. Very little information exists on the magnitude of the R & D externality, but what information there is indicates that the R & D externality may be as high as 77 per cent. This would imply that the R & D incentives of Canada and all the other countries examined are not sufficient to offset the R & D externality.

Thus the possibility exists that in all countries R & D activities that are socially beneficial are not undertaken because they are not privately beneficial. This is not a problem that can be solved by Canada alone. Indeed, as already indicated, it is not necessarily in Canada's interest to provide for substantially more generous tax treatment of R & D than do other industrial countries. In a world where technology can be developed in one location and used without compensation in many others, one may appeal to the taxpayers of a small country to provide a high level of support for R & D on altruistic grounds. An appeal based on self-interest would be much more difficult to sustain.

Earlier this study made the optimistic assumption that the introduction of R & D incentives would attract the footloose R & D activities of foreign firms.[1] That is, it was assumed implicitly that such firms could reduce their worldwide tax liability by conducting R & D in the country whose tax system treated it most favourably. Horst[2] has shown that there are circumstances under which this assumption is not valid. In the case of a Canadian subsidiary that remits all of its after-tax profit to its U.S. parent in the form of dividends, it can be shown that an R & D incentive that reduces the subsidiary's Canadian tax liability results in an offsetting increase in the parent's U.S. tax liability. Whether the parent and subsidiary together experience a net reduction in taxes depends on the differences between the two countries in the definition of taxable income and in the corporate tax rate. The reason that a tax reduction in Canada may be offset by a tax increase in the United States is that a reduction in the taxable income of the Canadian subsidiary does not reduce the "deemed" taxable income of the U.S. parent.[3]

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[1] See Chapter 2, under the heading "The Economic Implications of International Differences in the B-Index."

[2] Thomas Horst, "Impact of Income Taxes on the Profitability of Locating a Manufacturing Plant in Canada versus the United States" (mimeograph, Taxecon Associates, Washington, 1981).

It is virtually impossible to generalize the analysis of the interaction of national tax systems. Dividend or remittance policy will itself depend on international differences in the manner in which taxable income is determined. Consideration of three or more countries at a time complicates matters further. It can be concluded that possibly the marginal effect of a given R & D incentive on the B-index will differ between foreign and Canadian-owned firms. For this reason, even if it were desirable, it might be difficult to use tax expenditures to induce foreign firms to move their footloose R & D activities into Canada.

This study has concentrated on certain facets of the corporate tax system. It has ignored the impact of the tax system on the cost of financing R & D or investment in general and has also ignored a number of issues that relate more closely to R & D, including:

- the appropriate definition of R & D;
- the application of R & D tax incentives to individuals; and
- the transferability of credits and special allowances for R & D.

As the work of Strain[4] has indicated, these issues are worth exploring. It is important that future investigations be carried out to consider these issues and to study their possible effects on this study's results.

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[3] Ibid., at III-6.

[4] William J. Strain, "Tax and Other Incentives to Reduce R & D Costs," in *Current Developments in Measuring Business Income for Tax Purposes*, Corporate Management Tax Conference, 1981 (Toronto: Canadian Tax Foundation, 1982), 227-54.

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INDEX

Absolute standards
  adequacy of incentives, 84–87
After-tax cost
  by region, 37
  international differences, 13
  reduced 1952-1981, 33–35
  type of business, 38, 40
After tax cost and B-index
  Canada
    by firm size, 37–42
    by region, 37–42
    by type of R & D activity, 37–42
    over time, 33
    variable corporate tax rates, 35–37
After-tax income
  effect of allowances, 13–15
  effect of tax credits, 15–16
Allowances
  insufficient taxable income, 16
  20-country summary, 64–70
  types, 13–15
Allowances and corporate tax rates
  effect on B-index, 19
Atlantic region
  after-tax cost and B-index, 37–38
Australia
  tax treatment, 51
Austria
  tax treatment, 50–51
Average R & D dollar
  components, 25–28

Belgium
  additional investment allowances, 52–53
  expenditures, 51–52
  incentives, 52–53
Benefit-cost ratio
  minimums for 20 countries, 72–73
B-index
  by region, 37
  calculation assumptions, 70–71
  comparison of rankings, 76–77
  corporate tax rates, relationship to, 18–19
  defined, 17
  domestic and foreign expenditures, 41–42
  economic implications of international
    differences, 21–25
  for 20 countries, 72
  general expression, 71
  intramural and extramural expenditures, 41
  plant and equipment investments, 42–44
  reduced, 1952-1981, 33–35
  royalties, effect of, 20
  subsidies, 81–82
  tax credits, effect of, 19
  type of business, 38, 40
  use, 3, 9–10
B-index and after-tax cost
  variable corporate tax rates, 35–37
B-index value and tax treatment
  relationship, 17–18
Brazil
  tax treatment, 59
Britain *See* United Kingdom
Buildings and equipment
  proportion of expenditures, 27–28

Capital cost allowances
  20-country summary, 63–67
Capital expenditures
  consequences of misstating, 26
  general treatment, 12–13
Capital expenditures component, 26
Capital market distortions
  firm size and location, 39–40
Capital, physical
  choice, vs. R & D, 42–44
Chamber of Commerce
  recommendations, 1
Contracts
  B-index with subsidy element assumption,
    80–83
  defined, 78
  industrial support, 90
  studies, 7–8
  subsidy element, assumptions, 80–81
    studies, 79–80
  support and subsidy element, 78–79
Corporate tax rates
  after-tax cost and B-index, 35–37
  relationship to B-index, 18–19
Current expenditures
  general treatment, 12–13

Decision model studies, 5
Deductions
  capital expenditures, 30–32 passim
  current expenditures, 30–32 passim
  effect of timing, 12
  incentive scheme, 31
  insufficient taxable income, 16
  payments to nonprofit and taxable
    corporations, 30
  20-country summary, 63–67

Deductions and corporate tax rates
    effect on B-index, 19
Deferrals
    capital and current expenditures, 31–32
        passim
Denmark
    tax treatment, 53
Depreciation
    buildings and equipment, 28
    declining balance, 70–75
    straight-line, 70–71

Economic Recovery Tax Act (ERTA), 46
Economic studies, 4–10
Elasticity of demand
    studies, 8–9
Expenditures *See also* Current expenditures;
    Capital expenditures; Intramural
    expenditures; Extramural expenditures
    base defined, 31
    labour component, 27–28
    relationships to economic variables, 4–5
Externalities
    magnitude, 91
    positive, 23
    tax-subsidy treatment, 84–87
Extramural expenditures
    Canada, 29
    tax treatment, 41

Federal Republic of Germany
    capital expenditures, 47
    current expenditures, 47
    tax credits, 47–48
France
    capital expenditures, 48–49
    cash grants, 49
    current expenditures, 48
    qualifying investments deduction, 49

Germany *See* Federal Republic of Germany
Grants
    cash, Industrial Research and Development
        Incentives Act (IRDIA), 31

Hong Kong
    tax treatment, 60

Incentive rankings
    subsidy and contract components, 3
Incentives
    attraction of foreign firms, 91–92
    B-index reduction, 88–89
    value measured, 32–33
Income Tax Act, 30–32
Industrial Research and Development
    Incentives Act (IRDIA), 31
    credit, 34–35

Industrial spending and government incentives
    studies, 7
International R & D opportunities
    model, 24–25
Intramural expenditures
    in Canada, 26
    OECD countries, 27
    tax treatment, 41
Italy
    tax treatment, 53–54

Japan
    capital expenditures, 49–50
    current expenditures, 49–50
    government support, 90
    special deductions, 50
    tax credits, 50

Losses
    carryforward provisions, 16

Marginal benefit-cost ratio, 21–23
    elasticity, 89
    R & D externality, 84–87, 91
    20-country comparison, 72–73
Mexico
    tax credits, 59–60
    tax treatment, 59–60

National tax systems
    summary measure, 17–20
Net tax incentives summary measure *See*
    B-index
Netherlands
    B-index, 59
    tax treatment, 58–59
Norway
    tax treatment, 54
Nova Scotia task force
    recommendations, 1

Physical capital
    vs. R & D choice, 42–44
Private benefit cost-ratio, 84–87 passim
Production function studies, 6

Rates of return studies, 5–6
Resource allocation
    absolute standard, 3–4
Returns
    ratio of social to private returns, 84
Risk-bearing
    R & D and physical capital decision, 44
Risks and rates of return
    studies, 7
Royalties
    effect on B-index, 20

- Singapore
  - B-index, 61–62
  - tax treatment, 61–62
- Small business tax rate
  - eligibility, 39
- Social benefit-cost ratio, 84–87 passim
- South Korea
  - tax treatment, 60
- Spain
  - expenditures, 54-55
  - tax credits, 54–55
- Special deductions *See* Deductions
- Subsidies *See also* Tax subsidy system
  - compared with industrial spending, 80–81
  - defined, 78
  - impact on B-index, 80
  - industrial support, 90
  - percentage of R & D spending, 81
  - studies, 7–8
- Sweden
  - B-index, 57
  - expenditures, 55
  - special allowances, 55–57
- Switzerland
  - B-index, 58
  - tax treatment, 57–58

- Taiwan
  - tax treatment, 62
- Tax credits
  - firm size and location, 39–40
  - Industrial Research and Development Incentives Act (IRDIA), 31
  - insufficient taxable income, 16
  - rate changes, 32
  - 20-country summary, 64–70
  - types, 15–16
- Tax credits and corporate tax rates
  - effect on B-index, 19
- Tax incentives
  - liberalization advocated, 1
- Tax measures
  - studies, 7–8
- Tax-subsidy system
  - adequacy, 84–87
  - impact on spending, 88–89
- Tax system
  - domestic and foreign expenditure decisions, 41–42
  - intramural and extramural decisions, 41
  - investment decisions, 42–44
- Tax treatment
  - after-tax cost and B-index reductions, 33
  - by firm size, 37–40
  - by region, 37–40
  - by type of R & D, 37–38 passim, 40
  - Canada vs. less-developed countries, 66
  - Canada vs. major industrial countries, 64
  - Canada vs. small developed countries, 65
  - Canada's ranking, 75–76
  - Canadian summary, 32
  - evolution in Canada, 30–32
  - R & D and other investment forms, 4
  - 20-country summary, 63–70
- Taxable income
  - insufficient to reduce after-tax costs, 16
- Technology-oriented businesses, 39
- Transfer of wealth
  - government intervention, 9

- United Kingdom
  - tax treatment, 47
- United States
  - compared with Canadian tax treatment, 46
  - current expenditures, 45
  - equipment facilities expenditures, 45-46
  - investment tax credits, 45-46
  - tax credits, 46
- User costs
  - studies, 8–9

- Wealth transfer
  - impact on spending, 88–89
- Write-offs
  - time period assumptions, 71–75

**GLOBAL
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November 5, 1984

Ms. Beth Kuntz
Staff Assistant
House Ways & Means Oversight
Subcommittee
U.S. House of Representatives
Washington, D.C. 20515

Dear Ms. Kuntz:

In view of the House Ways and Means Oversight Subcommittee's recent hearings into the R&D tax credit, I believe you will find the enclosed article of substantial interest.

Industrial Innovation: Implementing the Policy Agenda, appeared last year in the Sloan Management Review. It addresses the efficiency and institutional attractiveness of the R&D tax credit as a means to stimulate industrial innovation. Based upon these criteria, the tax credit is a poor approach to the issue of stimulating innovation. The article also reviews the body of task forces which examined the question of stimulating industrial innovation, and the reasons why these efforts have had minimal impact on national policy.

In the two years since the above work was performed, we have examined other policy options which the U.S. might adopt to enhance the ability of domestic industry to compete in the global marketplace. If this work is of interest to your committee members, we would appreciate an opportunity to meet with you.

By way of background, the Global Competitiveness Council is an independent "think tank" monitoring the international trade arena. It now serves as a national focal point for research into the tools and techniques used by various nations to enhance their competitive position.

I look forward to hearing from you on this matter.

Sincerely,

Bruce Rubinger

Dr. Bruce Rubinger
Director of Studies

Sloan Management Review

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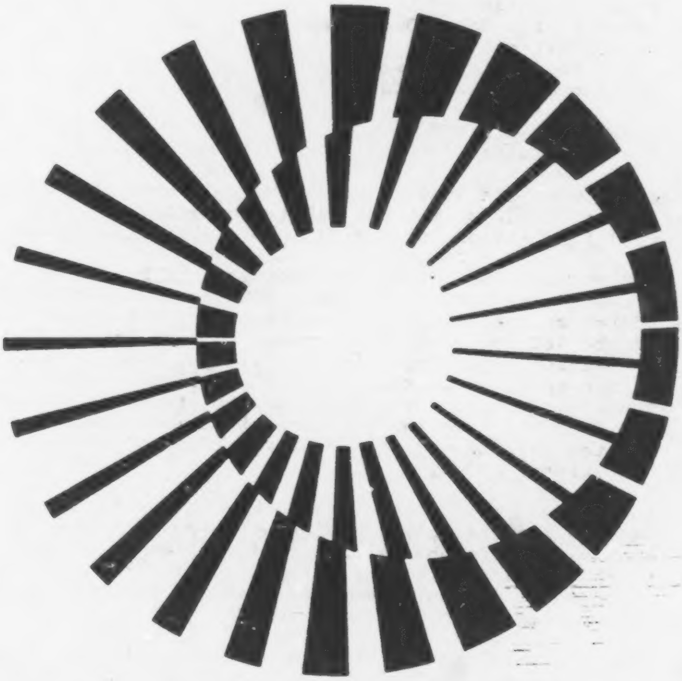

The Management of Corporate Banking Relationships
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About The Authors

Dr. Bruce Rubinger is a leading authority on the management of technology. He has devoted the past nine years to analyzing evolving patterns of international competition in technology intensive industries. This work has addressed such issues as research and development, international strategic planning and accelerating industrial innovation. He has also examined environmental scanning and its links to R&D management. Dr. Rubinger is currently the Director of Studies with the Global Competitiveness Council, an independent Boston-based "think tank" that conducts research into industrial competitiveness.

Dr. Rubinger's background is a blend of technology and the science of decision-making. He holds degrees in electrical engineering & controls systems, and a doctorate in decision-analysis from the Polytechnic Institute of New York. At the Massachusetts Institute of Technology he studied economics and system dynamics. In addition, Dr. Rubinger has developed case study material for the Harvard Business School's course on The Management of Technological Innovation. He has served as a senior policy analyst with the federal government, leading the interagency Comparative Industrial Policy project. Dr. Rubinger has also been an advisor to several management consulting organizations and Fortune 500 companies.

Industrial Innovation: Implementing the Policy Agenda

Bruce Rubinger **Global Competitiveness Council**

The issue of declining industrial innovation in the U.S. has been a concern of the nation's leaders for more than a decade. This article reviews the major efforts over the last two decades to stimulate industrial innovation, and discusses reasons for government inaction. Using this experience, the author presents a framework for examining the institutional attractiveness of alternative policy options, and develops guidelines for effective management interaction with the public policy process. *Ed.*

For more than a decade the perceived decline in industrial innovation in the United States has been a subject of concern to the nation's leaders. Recently this issue has become increasingly important because of intensified international competition and the concurrent deterioration in the U.S. trade position. In response, there have been numerous calls for the adoption of new federal policies to stimulate technological innovation, which will help to address national challenges in the energy, economic, and military spheres. Despite the time and effort devoted to these issues by business and government leaders, we are not much closer to their resolution today than we were a decade ago. This unfortunate situation does not reflect any lack of attention; a search of the literature reveals a large number of studies and recommendations generated by presidential commissions, government task forces, congressional committees, and industrial associations.

Advocates of policies to revitalize technological progress have cited their numerous benefits. Technological innovation has been the primary source of U.S. economic growth during the last century. High technology industries have exhibited about twice the increase in productivity, three times the growth rate, nine times the employment growth, and one-sixth the price increases that have characterized low technology industries.[1] Furthermore, there is a close correlation between R&D effort and international competitiveness; R&D intensive product groups (aircraft, computers, pharmaceuticals, chemicals, scientific instruments) contribute a net surplus to the U.S. trade balance.

In recognition of these benefits, our principal trade rivals have adopted policies that support and promote industrial research, development, and new product diffusion. The activist role of the Japanese government has received the most attention; MITI's "Vision for the Eighties" will accelerate the restructuring of the Japanese economy to focus on knowledge-intensive industries.[2] France will also be hard at work, stimulating industrial success in consumer electronics, automated manufacturing equipment, and biotechnologies.[3] Even the Federal Republic of Germany, with its free-market-oriented economy, has adopted a comprehensive package of direct and indirect support policies for stimulating innovation. These include tax incentives for R&D expenditures, public underwriting of cooperative research, government risk-sharing in venture capital formation, subsidies for the salaries of R&D personnel, and the provision of information on changing market conditions at home and abroad.[4] It is often argued that the U.S. should adopt comparable measures so that domestic firms are not at a disadvantage in world markets. The notion of adopting comparable measures is not new; it has been studied by government and private groups for at least two decades. Unfortunately, few managers in the private or public sectors are aware of this extensive experience.

As we look at the history of past studies on industrial innovation, it is clear that they have not had much impact on national policy. In order to succeed in the national effort to strengthen America's technology base and to avoid repeating the flawed formulas of the past, we must understand why these prior initiatives did not lead to policy implemen-

Bruce Rubinger is a member of the Global Competitiveness Council, a Boston-based think tank concerned with the competitiveness of U.S. firms in international markets. Dr. Rubinger holds the B.S. degree in electrical engineering from the City University of New York and the Ph.D. degree in systems science from the Polytechnic Institute of Brooklyn. He specializes in the strategic management of technology.

tation. This article reviews past efforts to stimulate industrial innovation and reasons for government inaction. Based on this experience, guidelines are developed for effective management interaction with the public policy process.

Changing Perspectives and Proposed Remedies

The Appendix describes the major studies that have addressed the issue of declining innovation, and Table 1 presents a kaleidoscope of recommendations to deal with this important problem. Examination of these studies reveals an evolving perception of innovation and its relation to economic growth.

During the sixties congressional efforts focused on improving the effectiveness of federally funded R&D, expanding its scope by applying technology to social problems, and exploring government's role in facilitating industrial innovation. The Bowen Commission established that government has a legitimate role to play in industrial innovation. Charpie's Panel examined the government's role in improving the environment for technological innovation through taxation, finance, and antitrust policies. The Ancker-Johnson study expanded government involvement by recommending that the Department of Commerce be an advocate for technological innovation, and by making proposals to improve the climate for technology-based enterprises. The Domestic Policy Review recommended a comprehensive federal approach to industrial innovation, which would incorporate complementary policy instruments.

In addition, during this period an understanding of the relationship between technological innovation and economic development slowly emerged. The Bowen Commission reported that there is a definite link between technology and economic progress. The Williams Commission noted the widespread impact that technological innovation has on the economy, and linked technological capability and economic growth to export performance and the U.S. position in international trade. By 1980 it was reported that "there is strong evidence that technological progress is perhaps the most important source of future economic vitality and social progress for the United States."[5]

Within Congress concern about the impact of fiscal policies on industrial innovation began surfacing in 1971. For example, the Subcommittee on Science Research and Development was required to assess the contributions by science and technology to the economy in order to determine an appropriate level of R&D support. In 1973 Congress initiated hearings on federal policy, plans, and organization in order to address the problem of fragmented jurisdiction over science, technology, and R&D. Although this debate over government organization has continued ever since without adequate resolution, there has been some change. For instance, the Stevenson-Wydler Technology Innovation Act of 1980 perceives technology in a much broader context than prior legislation, and defines an activist federal role in developing industrial technology.

In the seventies a fundamental change occurred in technology policy because of concern about government's intrusion into the private sector. Studies scrutinized the relationship among government technology policy, regulatory action, and private sector innovation, and as a result this linkage became better understood. Faced with declining national productivity and a loss of international technological leadership, many members of Congress felt that federal policy should focus on improving the climate for innovation, largely through regulatory reform.

In 1980 a new policy approach emerged in response to the nation's economic woes. The 1980 Joint Economic Report was symbolic of this change: in it both the majority and minority members of the Joint Economic Committee endorsed tax incentives directed toward investment in the economy.[6]

The Joint Economic Committee's report foreshadowed sweeping legislation — the

Table 1 Summary of Recommendations on Innovation by Government Commissions and Task Forces

Proposed Actions[†]	Bowen (1966)	Charpie (1967)	Williams (1971)	Ancker-Johnson (1977)	Baruch (1979)
Federal R&D					
Demonstration grants	X			X[*]	
Federal support of interdisciplinary university institutes	X				X
Direct support for R&D where it can influence innovation rate	X		X	X[*]	X
Trade Policy					
Priority to export promotion			X	X	X
Intensify efforts to insure U.S. technological lead			X		X
DOC, Treasury, & SEC cooperation on trade				X	
Technology assistance to less-developed countries				X	
Venture Capital					
Government should provide availability information		X			
Modify barriers to institutional purchases of venture capital				X[*]	X
Government Policy					
Study of innovation by DOC with universities		X		X	
Review policies to assess impact of federal actions on innovation		X		X	X
Interagency group should aid & advise regulatory agencies & others regarding their impact on innovation		X		X	X
Facilitate adjustment to change	X		X		
Economic Incentives					
Tax credits					
— Lengthen time allowed for deduction of losses		X			X
— Increase depreciation allowances		X		X[*]	X
— Accelerate depreciation allowances				X[*]	X
— Increase investment credit for R&D plant				X[*]	X
— Increase tax depreciation allowances for R&D plant				X[*]	X
— More generous capital gains tax rate for new firms				X[*]	
— New tax credit for R&D expenditures			X	X[*]	X
— Permit tax credits for contributions to nonprofit R&D institutions					X
— Permit R&D expenditures in U.S. to be allocated solely to U.S. income					X
— New tax credits for industrial R&D performers			X	X[*]	
Capital gains treatment same for casual inventor as businessperson inventor		X			
Liberalized stock options		X			X
Regulations					
Agencies must issue long-range statement of intent					X
Performance rather than design standards					X
Reevaluate antitrust policy			X	X	X
Provide economic incentives to offset regulatory costs					X
Strengthen data base for rule making		X		X	X
Account for impact on innovation		X		X	X

[*] Study proposed that the government investigate the use of these policies.

[†] Procurement actions, manpower development policies, and patent revisions have been omitted from this table.

Economic Recovery Act of 1981. Billed by the Reagan administration as the largest tax cut in history (almost $750 billion over a six-year period), the law contained incentives aimed at spurring savings and capital investment. These included a new tax credit designed to encourage businesses to increase their research and experimentation activities, and a measure to stimulate corporate contributions of research property to academic institutions.

The latest federal initiative is the Small Business Innovation Development Act of 1982. The program goes into effect in 1983, and will be phased in over a five-year period. The Act is designed to stimulate technological innovation by increasing the participation of small business in federal R&D efforts; it requires federal agencies to set aside a portion of their extramural R&D budgets for small business. One interesting feature of the Act is that it provides federal support to develop and evaluate a technological concept. The program is targeted toward the initial stage of the innovation cycle, where technical risk is highest and where small firms have encountered the greatest difficulty in obtaining private sector financing. The program is divided into three phases which correspond to concept evaluation, prototype development, and commercialization. A federal award would underwrite the first two phases, while private sector funding would be used to pursue commercial applications. To provide a link with the marketplace, during proposal evaluation special consideration will be given to those projects with private sector funding commitments for commercialization.

In retrospect, over the past two decades a broad spectrum of policies has been advocated for stimulating innovation. The principal recommendations focused on trade policy, regulatory reform, federal support for R&D, patent policy, government procurement practices, revamping the antitrust statutes, information incentives, facilitating adaptation to structural change, and strengthening the data base which supports public policy decision making. However, it was generally agreed that none of these policies would have as great an impact on innovation as tax incentives. Thus, the nonfinancial proposals would complement the use of tax incentives by facilitating the process of innovation within the private sector. The resulting policy agenda consists of an integrated package of the above proposals, combined in a manner that is consistent and mutually reinforcing.

Causes of Past Inaction

Although the issue of stimulating technological innovation has been continually studied, these efforts have had minimal impact on national policy. The causes of past inaction are reviewed below.

Aggregate Analysis. Past studies have examined the innovation process in the aggregate, rather than at the industry level. Yet, each industry has unique characteristics along such dimensions as technology intensiveness, maturity, structure, profitability, and exposure to foreign competition. These characteristics shape a sector's innovation pattern, and determine its perceptions of the "appropriate" federal action (see Table 2). For instance, procurement policies have been successfully used to support thin markets for new technologies such as semiconductors and aircraft; such policies would not be suitable for steel and autos, two mature industries. Because past studies did not provide a conceptual framework for predicting how specific sectors will respond to alternative government programs, they have limited value for policy formulation. This methodological flaw has also undermined efforts to create a national constituency for industrial innovation. For instance, Senator Howard Cannon made the following observation when commenting on the Domestic Policy Review of Industrial Innovation (a study undertaken during the Carter administration):

> This is not the first administration to treat the "innovation process" in the abstract. The studies

Table 2 Preferred Federal Policy Remedies by Firm Size and Technology Intensiveness

	Small Firm	Large Firm
High Technology	Lower Capital Gains Taxes Amend Pension Fund Investment Provisions R&D Set-asides Rollover of Capital Gains for Small Business Investment Enhance Integrity of Patents More Favorable Tax Treatment of Stock Options	Assure Full, Stable Federal R&D Funding New Tax Credits for Industry Investment in R&D Increase Tax Credit for Investment in R&D Plant & Equipment Permit Depreciation Based on Reacquisition Cost of Capital Monitor Multilateral Trade Agreements to Assure Compliance Government Financing of Exports at Preferential Rates
Mixed Technology	Reduce Corporate Tax Rates Immediate Write-off of Regulatory-related Expenditures Rollover of Capital Gains Eliminate Ceiling on Used Equipment Investment Tax Credit	Shorten Capital Recovery Period Capital Write-offs to Approximate Replacement Cost Flexible Depreciation of R&D Assets Patent Reform Limit Regulatory Actions by Reviewing Cost Effectiveness and Utilizing Economic Incentives to Spur Government Action
Low Technology	Reduce Corporate Tax Rates Regulatory Relief Reduce Inheritance Taxes	Provide Greater Capital Formation by Faster Depreciation, Investment Tax Credits, or Loan Guarantees Reexamine Trade Practices, Particularly to Assess Impact of Foreign Imports on Industries' Viability Regulatory Reform Provide Short-term Assistance to Workers & Communities Affected by Closing Old Facilities

dating back to the early 1960's have all cited examples of the Nation's past technological prowess but avoided mention of specific technological deficiencies that might arouse public concern or new technological opportunities that could generate enthusiasm and constituency support. Each study neglected the sector-by-sector assessment that is necessary.[7]

Lack of Institutional Memory. Because of the rapid turnover of high level government and industry executives, the same questions are continually raised and researched. This lack of institutional memory is exacerbated by the failure to develop case studies on policy initiatives (which would be one way to pass along the lessons from these experiences). This absence of "postmortems" reflects a failure to implement the policy recommendations, which in turn disillusions the study participants.

Inadequate Institutional Infrastructure. Because we lack the institutions necessary to authoritatively identify and debate alternatives, the result is drift and indecision. The nation's policies are increasingly late and reactive because of several glaring institutional weaknesses: the absence of well-defined national objectives and priorities;

the lack of an anticipatory analysis capability to guide policy formulation; the fragmented jurisdiction of congressional committees and their consequent difficulty in dealing with multifaceted issues (e.g., technology, trade, economic, and labor-adjustment concerns); and a legacy of antagonism between government and business which frustrates cooperative attempts to deal with national problems. As Senator Cannon noted in December 1979, "Technology, productivity, and investment are not central to any agency's concerns, however central they are to a nation's deteriorating position in an increasingly unstable world." In a speech at M.I.T. in October 1982, Senator Paul Tsongas addressed the same institutional issues. However, now the context was the nation's unpreparedness for a new era of technological change.

> We are entering a new era characterized by rapid technological advances, the evolution of domestic markets into global ones, and sharp international challenges to the U.S. technological and economic position. This new era is not widely recognized. As a nation we are not prepared for it. . . .
>
> In Japan the government anticipates technological developments, develops policies to shift resources into growing sectors, and assists firms in developing or diffusing innovations important to productivity. In the U.S. a blind commitment to free market principles limits the government to ad hoc responses like bailouts, exemptions from regulations, and tariff barriers.

Disjointed Nature of Studies. Because each of the industrial innovation studies was done in isolation, their results are repetitious, rather than progressive. The studies trumpet the virtues of innovation, but fail to address the institutional factors which frustrated the adoption of prior recommendations.

Lack of Consensus regarding Remedies. Although there is agreement about the virtues of innovation and economic growth, members of the business community have embraced divergent paths to this goal, including the following federal measures: modifications to depreciation schedules, corporate income taxes, and capital gains tax rates; federally funded R&D; regulatory reform; export promotion policies; and structural adjustment policies. The benefits of a particular policy will vary by industry; for example, accelerated depreciation would help capital-intensive industries (public utilities, petroleum refining, primary metals, mining) more than labor-intensive ones (farming, retailing). In general, large high-technology industries (such as aerospace) strongly favor sufficient, stable federal R&D funding; tax credits for industry's investment in R&D; government financing of exports at preferential rates; and depreciation schedules based on the reacquisition cost of capital. In contrast, small high-technology firms prefer policies that make capital gains more attractive, since stock options are their primary method of recruiting and retaining key technical and managerial personnel. This latter group of firms also places high priority on improving the reliability of the patent system, and on having a portion of the federal R&D budget (typically 10 percent) set aside exclusively for small businesses. Thus, while the private sector appears to be a natural constituency for proposals to spur innovation, its voice is muted by the divisiveness that stems from parochial self-interest. One example of how such narrow interest can immobilize change involved the Treasury Department's recommendations for "integrated taxes" in the seventies. This proposal would have spurred new investment in productive capacity through structural improvements in the tax laws (e.g., by eliminating double taxation of corporate dividends).[8] This recommendation was killed by the lukewarm public support it received from the Business Round Table.

Lack of an International Perspective. Traditionally, the principal competitors of U.S. corporations have been domestic rivals. Because of this legacy, U.S. firms lack an international perspective, which has contributed to our inability to forge a consensus on government policy. It also explains why U.S. firms tend to evaluate government proposals in terms of their differential impact on domestic firms within the same industrial

Table 3 Response to Potential Federal Initiatives by Domestic Auto Firms

Initiative	Positive	Negative	Remarks
Loan Guarantees	3	7	
Accelerated Depreciation and/or Investment Tax Credit	11	0	Must Be Refundable
New Car Purchase Incentives	3	9	Is Too Costly
Import Restrictions	6	6	
Retraining, Relocation, and Plant Conversion	7	1	
Fuel Economy Incentive Payments	0	8	
Risk Reduction	2		

Source: R. H. Shackson, "Pulling Together: Obstacles and Opportunities in Industry/Government Cooperation" (U.S. Department of Transportation Report No. DTRS-86-P-81504, April 1981, p. A-12).

sector. For instance, in 1979 the National Bureau of Standards launched its Cooperative Technology Program to support generic technology in areas that would help strengthen the domestic industrial base. In general, technologically advanced firms opposed the initiative because they believed that it would diminish their competitive edge. This trend was also evident in a recent study of opportunities for greater cooperation between the government and the auto industry.[9] Table 3 presents the divergent responses of the five domestic auto producers to potential government initiatives, illustrating that an industrial sector is not a monolith. Rather, the attractiveness of loan guarantees, accelerated depreciation, import restrictions, or other policies reflects such factors as a firm's commitment to global production, its cost structure, and its recent profitability. If the business community is to protect its interests, it must make an internal compromise and focus on broadly supported "satisficing" solutions, rather than on nonattainable preferred remedies.

Flawed Policy Formulation. To be seriously considered, a proposed policy must satisfy the evaluation criteria institutionalized in the federal review process. Many past recommendations have serious flaws when measured against these criteria.

Criteria for Evaluating Alternative Policies

When managers wish to influence the public policy debate, they need to understand how to press their case more effectively. In particular, the private sector needs to be familiar with how the government evaluates alternative policy options. The impact of proposed legislation is assessed in terms of four dimensions (which are institutionalized by federal review procedures): equity, likelihood of achieving the desired objective, efficiency, and administrative complexity. For example, the Office of Management and Budget's Circular All specifies the supporting information which must accompany any proposed change in tax policy. The evaluation criteria are described below.

Equity. Is the policy measure evenhanded, or will the advantages accrue to only a few sectors? The recent debate over funding for the Export-Import Bank centered on this issue. According to the bank's critics, "Two-thirds of its loans went to finance foreign purchases from seven large companies: Boeing, General Electric, Westinghouse, McDonnell Douglas, Lockheed, Western Electric, and Combustion Engineering." Similarly, when Congress attempted to fashion an auto industry aid package, the equity criteria question was raised: should consumers subsidize the salaries of auto workers whose 1982 wage and benefits compensation (about $22.20 per hour) was 60 percent higher than the average in manufacturing?

In general, it is difficult to justify policies that are targeted toward specific sectors. However, in the above Export-Import Bank case, proponents of government assistance argued that selective intervention was necessary to neutralize the export incentives provided to foreign firms by their host government.

Likelihood of Achieving the Desired Objective. Why is government intervention necessary for the desired objective to be achieved? How certain is it that the proposed policy will yield this goal? Other direct and indirect effects associated with the particular scenario will need to be identified (e.g., energy savings, productivity gain, employment impacts, balance-of-payments effects).

Efficiency. From an analytic perspective, a broad range of policies can be used to achieve the desired goal. The efficiency constraint, however, is to design a program that will accomplish the objective as economically as possible (generating the greatest impact per dollar of revenue forgone).[10] The efficiency question was raised in the 1980 congressional debate over President Reagan's depreciation proposal: was the proposed initiative too generous? Did it provide business with more tax breaks than were necessary to spur capital investment?

Administrative Complexity. To be practical, the information required for implementation must be readily available or obtainable at a low cost. Similarly, the administrative requirements to assure compliance must not be excessive. One frequently raised proposal which falters on the complexity criterion is the use of coupon rationing to deal with a petroleum supply disruption. Such a program would require a large work force to print, distribute, and collect the coupons and to deal with possible fraud and abuse. Thus, administrative difficulties rule out a reliance on this approach.

Measured against the above evaluation criteria, there are no perfect government policies. Rather, there exists a set of "satisficing" solutions, consisting of public policies which are efficient, which are tractable from an administrative perspective, and which have a high probability of achieving their objectives. In terms of the equity criteria, every government action creates winners and losers by altering the status quo. The challenge of the political arena is to achieve some balance — usually through internal compromise to increase the number of winners or through complementary legislation to partially mitigate adverse impacts. Thus, the policy process represents a blend of both analysis and negotiation. Although analysis can guide this process by identifying a set of "satisficing" solutions, it cannot stand alone. Any unbalanced approach to policy formulation (e.g., focusing exclusively on policy choices) is unlikely to achieve implementation.

Institutional Attractiveness of R&D Tax Credits

The evaluation criteria will now be illustrated by an assessment of the institutional attractiveness of additional tax credits for research and development expenditures. Such incentives have been advocated by many groups during the past decade. One popular proposal is to provide a credit equivalent to 10 percent of R&D expenses to offset corporate tax liabilities. Proponents argue that providing an incentive for R&D comparable to that given investment will stimulate technological innovation (e.g., by encouraging firms to undertake risky projects).

Equity. R&D expenditures are not distributed evenly across all industrial sectors. Rather, R&D activity is highly concentrated, with twenty companies accounting for 53 percent of all U.S. R&D expenditures. While those companies with less than 1,000 employees represent 91 percent of the firms performing R&D, they account for only 5 percent of total R&D expenditures.[11]

There are good reasons why larger corporations perform a disproportionate share of R&D. Few firms (other than major corporations) can afford the luxury of maintaining research centers with long-term programs which are relatively unaffected by business cycles.[12] However, from an equity perspective R&D tax credits are unattractive since the direct benefits are so highly concentrated.

Likelihood of Achieving the Desired Objective. The following industrial sectors are the main beneficiaries of R&D incentives: chemicals and allied products; petroleum, mining, and extraction; primary metals; fabricated metals; machinery; electrical equipment and communication; and motor vehicles. In these mostly mature industrial sectors with capital-intensive processes, implementation of change is very expensive and requires long lead times.[13] It is estimated that R&D in these sectors accounts for about 10 percent of the total cost of bringing a new product to market.[14] Thus, the R&D tax credit would reduce the cost of commercialization by only 1 percent, an amount which would have a negligible impact on a firm's investment decision. Ironically, these key R&D performing sectors are more sensitive to capital investment incentives than to R&D stimuli. A recent analysis by the Congressional Research Service included the following additional criticisms of an R&D tax credit:[15]

— The credit rewards the allocation of resources towards the earliest stage of the innovation process, rather than rewarding successful commercialization. However, many observers of the state of innovation believe that the current problems do not lie in the technical state, where the credit is focused, but in the commercial phase. Thus, the R&D credit is thought to be poorly targeted to stimulate innovation.

— The credit is unavailable to firms with no tax liability. This group includes new, technology-oriented firms which tend to operate at a loss for several years after start-up. In contrast, evidence suggests that this group has surpassed mixed and "low technology" industries in real growth, productivity gains, and employment.

Efficiency. According to the Treasury Department, if the 10 percent R&D credit had been available in 1980, it would have cost $1.9 billion.[16] Critics have questioned the cost-effectiveness of the measure, raising the following arguments:

— The amount of additional innovative activity it would stimulate is questionable (as discussed above).

— Much of the revenue loss would flow to firms that would have undertaken the R&D in the absence of the credit.

— Although the credit would apply equally to all R&D spending, only a small portion of R&D activity is devoted to risky innovations, which have the potential for a major payoff. It is this type of high-risk endeavor which needs special encouragement, rather than an effort that involves only minor product design changes.[17]

— The companies with the highest R&D expenditures are involved primarily in areas which are now experiencing diminishing returns. Although such research-intensive industries as chemicals, drugs, and electronics still produce the most innovations, the rate of innovation per R&D dollar is highest among (small) firms which spend the least. In addition, larger corporations are often too inflexible to exploit their inventions.[18]

Administrative Complexity. In their enthusiasm, advocates of the R&D credit have overlooked the fact that there is no strict definition of R&D spending. Firms differ in the types of activities they classify as R&D and in the costing and reporting of R&D operations.[19] For example, labor (the largest R&D expense) can be allocated either to overhead, to a specific operating unit, or to contract income. Since the allocation process is often arbitrary, an R&D tax incentive would encourage firms to reclassify existing expenses as R&D — this is a major flaw.

As the above discussion reveals, an R&D tax credit is seriously flawed when analyzed along the dimensions of equity, efficiency, and the likelihood of achieving the intended objective. Its administrative problems are major, requiring the development of a strict definition for R&D which, in turn, depends upon the feasibility of differentiating between the phases of the innovation process.

This example illustrates how failure to understand the nature of the policy analysis process can lead to misplaced emphasis with an attendant waste of time and energy. Such misplaced emphasis also carries a high opportunity cost, since the legislative process entails discrete "windows" for responding to national concerns.

An Attractive Policy Solution

The Small Business Innovation Development Act of 1982 provides an excellent example of a policy that addresses each of the four criteria for success.

Equity. From an equity perspective, the program is highly attractive. Because an estimated thirty to forty thousand small businesses meet the eligibility criteria, the benefits will be highly diffused. The program will also offset the current concentration of R&D efforts among a few large performers. (According to recent NSF statistics, the top twenty companies receive 73 percent of all federal R&D funds.)

Efficiency. Innovation studies have shown that small businesses are some of the most cost-effective R&D performers. For instance, small firms produce two to three times as many innovations per employee as larger organizations at half the cost per "research investigator" of larger firms.

Likelihood of Achieving the Desired Objective. Past experience with federal technology creation programs reveals a mixed track record. However, the program's prospects for success can be immeasurably enhanced if its administrative mechanism incorporates the lessons from past efforts. For example, two characteristics of previous successful efforts are an ability to forge a link with the marketplace and the emergence of a high-level project champion. These criteria can be satisfied by including on the proposal evaluation board senior-level managers from potential end-user firms. Under these conditions the likelihood that the program achieves its objective is moderate to high.

Administrative Complexity. The administrative complexity of the program falls in the moderate range; its key administrative challenge is to maintain the quality of the proposal evaluation process. This task will become more difficult as the program expands to its ultimate funding level of about $450 million a year. While the administrative difficulties are not insurmountable, the job of maintaining the interest and involvement of senior government and private-sector managers will be a challenge.

Generating New Solutions

In addition to providing a mechanism for evaluating existing proposals, the policy framework described above can guide the innovation debate by focusing attention on high-payoff solutions. In particular, the most successful R&D initiatives have been those that alter the rules of the game. For example, because of a willingness to accept risk and pay high prices to get a desired product, the Department of Defense's (DOD) procurement policies created a nurturing market which was critical for such major innovations as semiconductors and computers. Mitsubishi Heavy Industries successfully employed a variation on this approach when it recently developed an air-to-ship missile (ASM-1) similar to the French Exocet and the U.S. Harpoon. The Japanese version, however, exhibits greater accuracy than its foreign counterparts, and was developed for one-seventh the cost. The key to this technical achievement was the transfer of "knowledge of consumer goods production."[20] Mitsubishi's accomplishment, which challenges long-held American assumptions, recognizes that in many areas civilian technological developments lead those in the military sphere. By structuring R&D to promote a cross-fertilization of skills, dramatic gains can be made.

With federal R&D spending for national defense running about $26.4 billion in FY83 and with major new systems planned, there is a pressing need for R&D productivity gains. Mitsubishi's experience suggests one attractive solution: the nation can save billions by spending wisely. There are several ways to structure a new federal R&D initiative to incorporate the Japanese lesson. For instance, one might formulate a DOD Innovation Development Act of 1983, which would stimulate innovation by incorporating the perspectives of new performers. Like the Small Business Innovation Development Act of 1982, this Act would set aside a portion of DOD's R&D budget for firms currently excluded from DOD's programs (e.g., manufacturing systems organizations with no prior defense-related experience).

There are other ways to structure such an initiative, and the political arena is the appropriate forum for discussing the merits of these proposals. The above example illustrates that attractive solutions do exist which deserve considerable attention. An approach which has the potential for cutting the defense budget by billions, while simultaneously enhancing the accuracy of new military systems, should be a top priority of the public policy debate. We can no longer afford to just muddle through.

Conclusion

Effective public policy, like effective business policy, requires the determination of goals, the evaluation of alternative tactics for achieving these goals, and the ability to marshall resources behind the selected strategy. As U.S. policy paralysis over the last two decades illustrates, our public sector institutions which support this process are seriously flawed. Often operating with obsolete assumptions and outmoded institutions, the U.S. has responded to a changing international environment with late, crisis-oriented policies. This has created an environment which has placed domestic firms at a disadvantage in global markets.

To address these problems, managers must learn to think politically. Effective interaction with the policy arena requires that they be sensitive to the criteria used in public policy analysis. These factors constrain the set of feasible policy options while producing predictable shifts in preference. Moreover, to have its influence felt, the business community as a whole should seek "satisficing" solutions with a broad constituency, rather than fruitlessly pursue narrowly based "optimal" remedies. Through careful analysis, remedies should be identified that meet the criteria for institutional attractiveness. The government's role should be one of providing avenues for such solutions to emerge. One attractive model for this private sector/public sector interaction is the Japanese advisory council. These councils are the primary means by which the Japanese business community influences government policy. Perceived as authoritative bodies for identifying and debating national policy alternatives, their legitimacy depends upon the willingness of the participants to sublimate parochial concerns to larger national objectives.

Finally, it is important to recognize that the factors responsible for past U.S. inaction are still prevalent and that they are likely to thwart any new initiative. Policy choices cannot be evaluated independently of the policy process. Rather, policy remedies and the policy process must be mutually reinforcing for successful implementation to occur. As we prepare for a new era of technological challenge, the need for institutional innovation is pressing. Implementing such change represents the most important task facing America's managers over the next decade.

Appendix

By reviewing the literature on industrial innovation over the past twenty years, we can identify eight major studies, which are briefly described below.[21]

National Commission on Technology, Automation, and Economic Progress. As its 1966 report states, the primary concern of this Commission was that automation might lead to widespread unemployment. The Commission also dealt with the related issues of environmental pollution and the degrading impact of technology on the human condition. Its recommendations included: public and private policies to facilitate occupational adjustment to change; humanization of the work environment; the adaptation of technology to community needs; government support for experiments in the application of technology to social problems; and the adoption of the systems analysis approach to assess complex, large-scale social problems.[22]

Panel on Invention and Innovation. This Panel's mission was to explore opportunities for improving the climate for technological change through antitrust, taxation, and regulatory policies. In its 1967 report, the Panel, which was composed of businesspeople, jurists, and academics, found that many industries were underinvesting in innovation. To identify the cause of this problem, the Panel examined the differences between highly innovative industries and relatively uninnovative industries, finding that the major difference was one of attitude and environment (not of antitrust, taxation, or capital availability).[23] Accordingly, the Panel did not recommend major changes in laws governing taxation, finance, and competition, but rather suggested changes in the interpretation and administration of these laws to improve the environment for innovation. It made the following proposals which were targeted at small, technologically based companies: a more equitable treatment of innovation losses, enhancement of the stock option to attract critically important managers to fledgling firms, and the placement of professional inventors on the same tax footing as amateur inventors.

Commission on International Trade and Investment Policy. This Commission was asked to examine U.S. problems in foreign trade and investment and to produce recommendations to meet the challenges of the changing world economy of the seventies. Composed mainly of chief executive officers from major U.S. corporations and some labor leaders and academics, the Commission met with Cabinet members, top officials of U.S. agencies dealing with foreign economic policy, and the heads of principal international organizations concerned with international trade, finance, and investment. It also consulted a broad spectrum of other experts in business, labor, the universities, and government.

In its 1971 report, the Commission stated that technology-based products were the principal U.S. asset in meeting the import competition.[24] To address the declining U.S. technological lead, the Commission recommended: a higher level of government support for R&D directed to industrial objectives, tax incentives for investment and R&D, a more flexible policy on mergers consistent with competition and economic efficiency, regional development policies, and measures to remove structural impediments to the mobility and productivity of U.S. labor and capital. To stimulate exports, the Commission called for a review of U.S. policies (antitrust, import duties, procurement, nontariff barriers, taxation, environmental regulations) to see if they were impeding export performance.

National Academy of Engineering/National Research Council. In 1976 the Committee on Technology and International Economic Issues of the National Research Council examined the interrelationship between technological innovation and the vigor of the U.S. economy.[25] Its concerns encompassed: technology and its effect on trade between the

U.S. and other OECD countries, relationships between technological innovation and U.S. productivity and competitiveness in world trade, and the impact of technology and trade on U.S. employment levels. Attributing the declining U.S. lead in technological innovation to the lagging rate of capital formation, the Committee's report recommended: more U.S. government financial support for research and education affecting productivity and innovation in commercial technology; an inquiry into the comparative age and quality of the stocks of capital goods, arranged by industrial sectors, in the U.S. and other countries; and an inquiry about ways to foster U.S. technological innovation (e.g., tax policy and incentives, regulatory policy, antitrust practices).

In 1978 a second phase of the study examined the impact on industrial innovation of regulation, tax and financial regulatory policies, and antitrust policies.[26] The Committee summarized the impact of public policy on firms' investment behavior, and recommended changes in policy that would stimulate innovation.

Department of Commerce's Study of U.S. Technology Policy. In 1977 this study cited the contradictory nature of U.S. technology policies, and called for the development of a coherent national policy which would promote private sector investment in technological innovation.[27] Its recommendations included: establishment of an industrial technology analysis office; direct and indirect federal incentives for industrial R&D; reduction of regulatory-related barriers to innovation; improvement of the climate for start-up technology-based companies; improvement in the dissemination of information on innovation to state and local governments; export promotion of technology-intensive products; streamlining of export control procedures; and technological support of less developed countries.

Committee for Economic Development. In 1978 CED, a nonprofit organization, established a subcommittee of twenty-five top business executives and five university presidents to assess the causes of declining U.S. technological progress and to formulate public policies for reversing this situation. Its report identified public policies that discouraged investment in new facilities, caused business to be defensive rather than creative, and reduced incentives for investment in R&D.[28] The study examined a wide spectrum of public policies that influence the innovation process, including tax policy, regulatory policy, patent policy, international technology transfer, and federal support of R&D.

Domestic Policy Review of Industrial Innovation. In 1978 an interagency committee was formed to study seven areas affecting industrial innovation: economic and trade policy; regulation of industry structure and competition; direct federal support of R&D; patent policy; information policy; environmental, health, and safety regulations; and federal procurement policy. A series of background papers were commissioned to review current knowledge of the innovation process and the stimulatory policies employed by other industrial nations. The revised versions of these papers were published in a book entitled *Technological Innovation for a Dynamic Economy.*[29]

Commerce Technical Advisory Board. In 1978 the CTAB, an advisory body to the secretary of commerce, created a committee of thirteen industry and university representatives to assess the factors behind the decline in the number of small, technologically oriented firms and to develop policy recommendations for restoring the economic vigor of these enterprises. The committee's report cited the central role of technological innovation in job creation, productivity advance, and the maintenance of international competitiveness. If small, technologically innovative businesses experience difficult times, a general decline in U.S. innovation can be expected since small firms were found to have a much greater efficiency in innovation.[30] Twelve recommendations were made to restore the vigor of small enterprises, including increasing the availability of capital and management expertise, reducing the regulatory burden, stimulating technology diffusion and application, increasing small business R&D, and stimulating small business exports.

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